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VOLUME 3 NUMBER 21

Scientific and Technical Aerospace Reports

A Semimonthly Publication
of the National Aeronautics and Space Administration

November 8, 1965

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N65-32646* # National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPLORATORY EXPERIMENTAL AERODYNAMIC INVESTIGATION OF TENSION SHELL SHAPES AT MACH 7
James C. Robinson and Alfred W. Jordan Washington, NASA, Sep. 1965 43 p refs
(NASA-TN-D-2994) CFSTI: HC $2.00/MF $0.50 CSCL 01A

An exploratory experimental study of tension shell shapes for use in unmanned, planetary entry has been conducted. The tests were performed in the 7-inch (17.8-cm) Mach 7 pilot tunnel at the Langley Research Center at a stream stagnation temperature of approximately 3420° R (1900° K) and at Reynolds numbers ranging from 0.043×10^6 to 0.173×10^6. The test medium was the combustion products of methane and air. The data collected were aerodynamic force and moment measurements, pressure distributions, and heating rates. Flow separation from the surface of a tension shell shape was found to be the most important factor affecting its aerodynamic characteristics. The major significance of model length and nose bluntness was the effect on the extent of flow separation. Measured pitching-moment coefficients for the two relatively short models were slightly positive for nearly all angles of attack at which tests were made. The experimental pressure distributions obtained for these two models indicated that the assumption of a Newtonian pressure distribution is not valid. Heating studies showed that increasing the length of the tension shell configurations incurred attendant increases in the total convective heating rate if the flow remained attached to the body surface. Author

N65-32782# Sandia Corp., Albuquerque, N. Mex.
TRANSIENT BASE PRESSURE STUDY OF AN AXI-SYMMETRIC SUPERSONIC MISSILE FLYING HEAD-ON THROUGH A BLAST WAVE
G.W. Zumwalt and H. H. Tang (Okla. State Univ.) May 1965 125 p refs
(SC-TM-65-218)

The problem is divided into two parts: blast wave passage and post-passage transients. The relation of base pressure versus time was sought by analytical means. For the first part of the problem, a flow model was devised for the conditions before and after the blast front passage over a slender axi-symmetric missile. A solution was obtained by a transformation to a wave-attached coordinate system. For the transient conditions following the blast front, a quasi-steady approach was adopted, using time iteration. To do so, it was necessary to extend Zumwalt's conical wake method for steady flow to include mass transfer from the airstream to the separate air at the base. A wind tunnel test program was designed and data analyzed to obtain empirical information required for effective conical jet pumping surface. These tests included both steady-state and transient base pressures. An analysis has resulted which is experimentally verified for simple base pressure transients, and which gives a prediction of base pressure-time history for head-on blast wave intersection with axi-symmetric missiles. Author

N65-32870* # National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AERODYNAMIC LOADS ON TAILS AT HIGH ANGLES OF ATTACK AND SIDESLIP
S. Richard Spahr and Edward C. Polhamus Washington, NACA, 23 Jul. 1957 25 p refs
(NACA-RM-A57E21) CFSTI: HC $1.00/MF $0.50 CSCL 01A
(Declassified)

Results are presented for the loads and moments acting on the individual tail surfaces of a body-tail combination over a wide range of angles of attack and sideslip. The effects of forebody length and panel-panel interference on the characteristics are included. It is shown that large nonlinear variations in these loads and moments, which occur at some combinations of angle of attack and sideslip, cannot be predicted by lowangle theory. A theoretical method for calculating these load and moment characteristics is described, and results are found to be in good agreement with experiment. It is shown that a simple application of slender-body theory can be used to predict the side loads due to sideslip that are contributed by a vertical tail on a wide variety of wing-body-tail combinations at low angles of attack. Presented are some results on the effect of high angle of attack on the induced-flow field and tail loads due to a wing at supersonic speed. Author

N65-32873* # National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PRESENTATION ON FACILITY PROBLEMS IN HIGH-TEMPERATURE STRUCTURES RESEARCH

Paul E. Purser and Richard R. Heldenfels Washington, NACA, 27 Mar. 1956 40 p
(NACA-RM-L56C24) CFSTI: HC $2.00/MF $0.50 CSCL 01A
(Declassified)

This presentation is intended to reflect the current general approach of the NACA to the problems of high-temperature structures research facilities. The facilities and problems discussed apply to flight in the Mach number range from 2 to about 20. It is emphasized that this field is one in which the thinking is rapidly changing and the facilities investigations discussed, particularly for the higher temperature range, are in the exploratory stage. Author

N65-32941# Electronic Associates, Inc., Princeton, N. J. Research and Computation Div.
HYBRID COMPUTATION FOR SIMULATION OF THE MOTION OF AEROSPACE VEHICLES
E. E. L. Mitchell, W. G. Hagerbaumer, and J. B. Mawson Jul. 1964 168 p refs
(Contract AF 04(611)-9676)
(AD-464829)

After a basic introduction to the equations of motion of a rigid body and a discussion of coordinate systems appropriate to aerospace flight, general purpose programs are developed for use in the hybrid simulation of the motion of an aerospace vehicle for various flight regimes. Detailed programs are included for the digital section covering full mission—launch to landing—orbital flight. Energy management by footprint display and digital function generation are also discussed. Author

N65-32944# White Sands Missile Range, N. Mex. Electro-Mechanical Labs. Div.
NON-LINEAR MATRIX RICCATI RELATIONS OCCURING IN FLIGHT DYNAMICS Internal Memorandum No. 3
J. S. Pappas and K. C. Grover Nov. 1964 38 p refs
(AD-464875)

Systematic techniques for handling (or packaging) of n-tuples of n-tuples of position, velocity, and acceleration vectors are shown for obtaining Riccati relations in a flight vector dynamics study. A geometrical insight into the relations described by the matrices is presented. Some aspects of generalized dynamical systems discussed are matrices of invariant representations; matrices of matrices of coordinates; and the alias-alibi aspect. Vector system equations of motion are considered for first and second derivative vector-matrix relations. Calculations are also shown for the trajectory of a vector $\bar{x}$ and one arbitrary time-varying basis $<\bar{y}$; and the trajectory of a vector $\bar{x}$ and two arbitrary time-varying bases $<\bar{y}$ and $<\bar{z}$ (42 integrations). L.S.

N65-33126*# Virginia Polytechnic Inst., Blacksburg.
LAMINAR FLOW PAST A SPHERE AT HIGH MACH NUMBER
R. T. Davis and W. J. Chyu [1964] 27 p refs Submitted for Publication
(Grant NGR-47-004-006)
(NASA-CR-64595) CFSTI: HC $2.00/MF $0.50 CSCL 01A

A set of equations valid in the entire shock layer, which is an approximation to the Navier–Stokes equations for high Reynolds number, was numerically integrated. These equations are integrated by starting at the stagnation point and integrating downstream using an implicit finite difference method. The case considered was for the constant density viscous flow past a sphere, however, the method for handling the compressible case is completely analogous. The results obtained agree with those obtained from the series truncation solution and also with the inviscid constant density solution of Lighthill when the Reynolds number is high enough. Effects such as shock structure and slip were not included but can be considered since the numerical procedure for solving the governing equations is clear. The method can be used for determining solutions to problems such as the flow far downstream on a hyperboloid in compressible supersonic flow. From the boundary layer point of view, the solution in the region where the entropy layer and boundary layer merge is not clear, but they are of no concern since the entire shock layer is treated at once. R.N.A.

N65-33163# Texas A&M Univ., College Station. Graduate Coll.
THE EFFECT OF TANGENTIAL MASS ADDITION ON THE BOUNDARY LAYER VELOCITY DISTRIBUTION OF A FLAT PLATE AT ZERO ANGLE OF ATTACK
Edward Peter Miller (M.S. Thesis) Aug. 1965 71 p refs
(AD-617293)

An investigation was conducted to determine the effects of low velocity tangential blowing on the boundary layer of a flat plate at zero angle of attack. It was found that there is little or no correlation between tangential blowing into a moving stream and the turbulent wall jet. The boundary layer thickness is not markedly influenced by the boundary layer control coefficient for small blowing rates. The depth of the mixing zone between the jet velocity and undisturbed boundary layer velocity is a function of the jet and free stream velocities. The variation of velocity in the boundary layer above the mixing zone is greatly influenced by pressure gradient. The value of n in a 1/nth power-velocity-distribution for the profile from the surface to the height of maximum velocity in a blown boundary layer varies considerably for different blowing rates and distances from the blowing slot. The normally accepted boundary layer theory that n = 7 may be far from correct. Tangential blowing has an adverse effect on the lower portion of the boundary layer upstream of the blowing slot. The cause of this effect is not fully understood. R.N.A.

N65-33198# Lockheed-California Co., Burbank.
DEVELOPMENT OF A POWER SPECTRAL GUST DESIGN PROCEDURE FOR CIVIL AIRCRAFT
F. M. Hoblit, N. Paul, J. D. Shelton, and F. E. Ashford 20 Apr. 1965 455 p refs
(Contract FA-WA-4768)
(Rept.-18253; AD-464271)

Studies were undertaken to provide a recommended form for a gust loads criterion based on power-spectral concepts; to establish design levels based on strength of a satisfactory existing airplane, taking into account the significant rigid body and elastic modes; to provide a practical technique for using statistically defined loads in stress analysis, and to illustrate by application to an existing airplane; and to investigate the sensitivity of the results to data and methods. It was noted that variations in the methods of analysis were found to have a sizable effect on the loads obtained. Consequently, for the envisioned criterion to be relied upon to provide adequate structure, it was necessary to obtain a specific indication of the variations in the resulting design loads that might be produced by variations in the input data used in the loads determination. Also, there are subtle differences among various mathematical models, even though these models may all be of the same general level of complexity. R.W.H.

N65-33263*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE EFFECTS OF SOME VARIATIONS IN LAUNCH VEHICLE NOSE SHAPE ON STEADY AND FLUCTUATING PRESSURES AT TRANSONIC SPEEDS
Charles F. Coe Washington, NASA, Mar. 1962 55 p refs (NASA-TM-X-646) CFSTI: HC $3.00/MF $0.50 CSCL 01A (Declassified)

Steady and fluctuating pressures have been measured along the top center lines of five bodies of revolution within the Mach number range from 0.6 to 1.2. Three models had ellipsoidal noses with fineness ratios of 2 on afterbodies which were cylindrical or converging. One model had a fineness-ratio-1/2 ellipsoidal nose, and one model had a cone-cylinder nose with a diverging section in the afterbody. The results of the investigation showed that pressure fluctuations and possible unsteady bending loads on a vehicle with a cylindrical body are small if the nose is sufficiently slender. Boattailing or a reduction in cross-sectional area following a slender nose results in separation of flow and extensive regions of pressure fluctuations. The sharpness of the area reduction affects the Mach number range over which these pressure fluctuations occur. Comparison of power spectral densities of the fluctuations on all the models tested indicated that they are dependent upon the location within a particular type of flow and are not peculiar to a specific model profile. Author

N65-33267*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TABULATED PRESSURE DATA FOR A SERIES OF CONTROLS ON A 40° SWEPTBACK WING AT MACH NUMBERS OF 1.61 AND 2.01
Douglas R. Lord Washington, NACA, 8 Nov. 1957 336 p refs (NACA-RM-L57H30) CFSTI: HC $7.00/MF $2.00 CSCL 01A (Declassified)

An investigation has been made at Mach numbers of 1.61 and 2.01 and Reynolds numbers of 1.7×10^6 and 3.6×10^6 to determine the pressure distributions over a swept wing with a series of 14 control configurations. The wing had 40° of sweep of the quarter-chord line, an aspect ratio of 3.1, and a taper ratio of 0.4. Measurements were made at angles of attack from 0° to ±15° for control deflections from −60° to 60°. This report contains tabulated pressure data for the complete range of test conditions. Author

N65-33268*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
EXPERIMENTAL AND THEORETICAL DETERMINATION OF FORCES AND MOMENTS ON A STORE AND ON A STORE–PYLON COMBINATION MOUNTED ON A 45° SWEPT-WING-FUSELAGE CONFIGURATION AT A MACH NUMBER OF 1.61
Odell A. Morris, Harry W. Carlson, and Douglas J. Geier Washington, NACA, 30 Jan. 1958 124 p refs (NACA-RM-L57K18) CFSTI: HC $4.00/MF $1.00 CSCL 01A (Declassified)

An investigation of store-pylon forces and moments has been conducted in a 4- by 4-foot supersonic pressure tunnel at a Mach number of 1.61. Separate forces and moments were measured simultaneously on a store and on a store-pylon combination for a number of pylon-mounted store locations below the wing of a 45° swept-wing–fuselage combination. Tests were made through an angle-of-attack range of −4° to 12° and an angle-of-sideslip range of −12° to 12°. The basic model configuration simulates a heavy-bomber-type airplane with a large ogive cylinder store. The results of the investigation indicate that the most important source of store-pylon side forces is the pylon itself. When immersed in a strong sidewash field, the pylon can assume a large load and also produce a large incremental load upon the store. Both tend to increase rapidly with increasing angle of attack or angle of sideslip. Author

N65-33269*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INVESTIGATION OF AN ALL-MOVABLE CONTROL SURFACE AT A MACH NUMBER OF 6.86 FOR POSSIBLE FLUTTER
William T. Lauten, Jr., Gilbert M. Levey, and William O. Armstrong Washington, NASA, 8 May 1958 20 p refs (NACA-RM-L58B27) CFSTI: HC $1.00/MF $0.50 CSCL 01A (Declassified)

Results of tests for possible flutter of a dynamically and elastically scaled model of a proposed all-movable horizontal tail surface for the North American X-15 airplane are presented herein. Tests at a Mach number of 6.86 were made on the scaled model and on several other configurations having lower stiffnesses. No flutter was obtained. Flexibility influence coefficients and calculated modes and frequencies for the weakest configuration are presented. Calculations of flutter speed of the weakest configuration (piston-theory aerodynamic forces, calculated mode shapes, and experimentally determined frequencies in a modal-analysis calculation scheme being used) yielded a flutter speed approximately four times as high as the velocity obtained in the tests. Author

N65-33274# Weapons Research Establishment (Australia).
AN ANALYSIS OF THE DISPERSION OF THE SKYLARK VEHICLE FOR ALL FIRINGS UP TO DECEMBER 1961
D. G. Merchant May 1965 35 p refs (WRE-HSA-105) CFSTI: HC $2.00/MF $0.50

The corrections applied to Skylark basic trajectories to account for the effect of wind, initial conditions and Coriolis force are described, and the measured dispersions of the impact point are presented for forty-four Skylark trials which were conducted during the period ending December 1961. The standard deviations, as a measure of dispersion, are determined using both pre-firing and time of fire wind data. The contribution to the dispersion, of errors in the applied corrections and of other sources is analyzed, and it is concluded that of those for which some control is at present possible, the pre-firing variation of the estimated wind correction with time and change of rocket motor performance from that assumed, are the two main contributors. Author

N65-33337# General Applied Science Labs., Westbury, N. Y.
CALIBRATION OF A MACH 12 SQUARE NOZZLE
J. Ranlet Arnold AF Station, Tenn., Arnold Eng. Develop. Center, Jul. 1965 31 p refs
(Contract AF 40(600)-1120)
(GASL-TR-531; AEDC-TR-65-167; AD-467022)

An experimental investigation was made of the flow field in the test section of a Mach 12 nozzle having all square cross sections. Pressure as well as temperature measurements were made in the test section of the nozzle. The results show that the Mach number within the test rhombus of the nozzle was 12.10 ±0.20. Furthermore, the problem of focusing, which is usually encountered in axially symmetric nozzles, is eliminated. Author

N65-33346# Princeton Univ., N. J. Dept. of Aeronautical Engineering.
HYPERSONIC STUDIES OF WAKES BEHIND CYLINDERS. PART I: PITOT PRESSURE MEASUREMENTS AT M = 16 IN HELIUM

J. D. Ledger, I. E. Vas, S. M. Bogdonoff Jun. 1965 42 p refs (Contracts Nonr-1858(37); AF 33(615)-1079) (Rept.-739; AD-467691)

The pitot pressure was measured in the wake of two-dimensional circular cylinders at a Mach number of 16 in helium. The diameters of the cylinders used were 1/8 inch and 3/16 inch giving a Reynolds number variation of 10,500 to 25,300 based on free stream conditions. Surveys were performed as far back as 80 body diameters. Profiles in the far wake at the same x/D were similar, independent of body Reynolds number. The wake growth was found to vary as the 0.6 power. Body Reynolds number had no effect on the rate of growth over the range studied. It was not possible to deduce transition from the pitot pressure measurement alone. Author

N65-33357*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

FLIGHT-DETERMINED LOW-SPEED LIFT AND DRAG CHARACTERISTICS OF THE LIGHTWEIGHT M2-F1 LIFTING BODY

Victor W. Horton, Richard C. Eldredge, and Richard E. Klein Washington, NASA, Sep. 1965 44 p refs

(NASA-TN-D-3021) CFSTI: HC $2.00/MF $0.50 CSCL 01A

The low-speed lift and drag characteristics of a manned, lightweight M-2 lifting-body vehicle were determined in unpowered free-flight tests at angles of attack from 0° to 22° (0.38 radian) and at calibrated airspeeds from 61 knots to 113 knots (31.38 to 58.13 meters/second). Flight data are compared with results from full-scale wind-tunnel tests of the same vehicle. The investigation showed that 95 percent of the vehicle maximum lift-drag ratio of 2.8 was available through an angle-of-attack range from 4.4° to 14.6° (0.08 to 0.25 radian). Although this lift-drag ratio is considered to be low in comparison with most other aircraft, no serious difficulties were experienced in landing the test vehicle. The lift and trim characteristics were linear in the angle-of-attack range from 0° to 15° (0.26 radian). Although the same vehicle was tested in flight and in the wind tunnel, significant differences existed in the values of zero-lift drag and drag due to lift. Author

N65-33366*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

AERO-ASTRODYNAMICS RESEARCH REVIEW NO. 2, JULY 1, 1964–DECEMBER 30, 1964

1 Apr. 1965 172 p refs

(NASA-TM-X-53295) CFSTI: HC $5.00/MF $1.00 CSCL 01A

A number of aerodynamics and astrodynamics research articles are presented on aerodynamics, communication theory, facilities research, flight evaluation, instrumentation, mathematics, and orbit theory. R.N.A.

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N65-32704# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Flight Dynamics Lab.

SOD AND MATTED LANDING SURFACE ROUGHNESS CHARACTERISTICS Technical Memorandum, Aug.–Sep. 1964

B. H. Groomes [1964] 55 p refs

(FDDS-TM-64-32; AD-617544)

Limited sod and matted surface characteristics in the form of profile and power spectral density plots, discrete bump and dip distributions and maximum heights and depths for various wavelengths are presented. These runway roughness data were obtained from profile surveys of the Hughes Aircraft Company's sod field and the United States Marine Corps, Twenty-Nine Palms California multi-matted runway. The multi-matted runway was constructed from Convair aluminum matting (first 1500 feet), pierced steel planking (second 3500 feet) and M9MI aluminum matting (last 1000 feet). The power spectral densities for the sod and multi-matted surfaces show higher roughness characteristics than the power spectral density for the roughest prepared surface which had been previously established from a survey of 25 air bases throughout the United States. Also, for the limited data gathered, the multi-matted surface was rougher than the sod surface. Author

N65-32748# Bolt, Beranek, and Newman, Inc., Los Angeles, Calif.

HELICOPTER NOISE CHARACTERISTICS FOR HELIPORT PLANNING

Dwight E. Bishop Mar. 1965 71 p refs

(Contract FA-64-WA-4949)

(FAA-ADS-40; AD-617764)

For estimating noise levels of helicopters during takeoff, landing, flyover, and hovering operations, noise data and analytical procedures are presented. Helicopter noise and noise due to other sources typically found in urban and suburban areas are compared in the interest of heliport planning. The data are presented in the form of noise contours and noise-versus-distance charts for various types of civilian and military helicopters. J.M.D.

N65-32770# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

NEW GLIDERS

V. Plaksin 12 Jul. 1965 8 p Transl. into ENGLISH from Kryl'ya Rodiny (USSR), no. 7, 1960 p 17–18

(FTD-TT-65-833/1+2+4; AD-617946)

The construction, instrumentation, and performance of two all metal gliders is discussed. The first is a soaring glider of standard class that attains a high aerodynamic quality by a greater aspect ratio, a fuselage with a small middle, a smaller washed surface of air brakes at the trailing edges of the wings and an improved landing gear fairing. It reaches a maximum speed of flight by strength conditions of 250 km/hr. The second glider is a twin seater for use in initial training. Its instrument board is situated in the forward cockpit and is easily viewed from the rear cabin where the instructor is seated. Its maximum flight speed by strength conditions is 250 km/hr. G.G.

N65-32850# Lockheed-California Co., Burbank.

DEVELOPMENT OF A POWER-SPECTRAL GUST DESIGN PROCEDURE FOR CIVIL AIRCRAFT

Frederic M. Hoblit, Neil Paul, Jerry D. Shelton, and Francis E. Ashford Jul. 1965 493 p refs

(Contract FA-WA-4768)

(Rept.-18253, Rev. 2)

Three alternate forms of gust loads criterion based on power-spectral concepts are developed. These include a mission analysis criterion, a design envelope criterion, and a criterion combining advantages of each. The latter is recommended for design use. Design levels are determined based on the strength of three existing satisfactory airplanes, the Lockheed Model 749 (Constellation) and Model 188 (Electra) and the Boeing Model 720B. The determination of design loads involves dynamic gust analysis of the three airplanes, taking into account the significant rigid body and elastic modes for both vertical and lateral gust inputs, as well as detailed stress analysis to the resulting loads. The appropriate limit design frequency of exceedance (mission analysis criterion) is found to be 2×10^{-5} exceedances per hour. The appropriate limit design value of $\sigma_w g_d$ (rms true gust velocity times ratio of design load to rms load, for use in a design envelope criterion) varies linearly from 56 fps at sea level to 62 fps at 7000 ft, to 55 fps at 27000 ft, to 17 fps at 80000 ft. Two techniques have been developed for integrating the statistical determination of loads with the detailed stress analysis. Author

N65-32853# Battelle Memorial Inst., Columbus, Ohio.
ANALYTICAL STUDY OF AIRCRAFT ARRESTING GEAR CABLE DESIGN Final Report
P. T. Gibson and H. A. Cress 28 May 1965 88 p refs
(Contract NOw-64-0461-f)
(AD-617788)

As aircraft arresting cable design and testing showed peak tension at the point of hook impact, an analysis of the effects of the wire rope constructional variations on the peak tensile stress in the cable was undertaken. Calculations show that the maximum internal stresses experienced by a flattened strand, Lang-lay cable are a function of cable elastic modulus and the ratio of cable density to metallic cross sectional area. A strong recommendation for the use of plated wire in purchase cable is included; the hook-cable impact situation is defined analytically showing that the geometry and wire shape affect the problem of abrasion resistance. W.M.R.

N65-32860# RAND Corp., Santa Monica, Calif.
THE ANTECEDENTS OF THE X-1
Robert L. Perry Jun. 1965 40 p refs Presented at the Meeting of Am. Inst. of Aeron. and Astronautics, San Francisco, 26-28 Jul. 1965
(P-3154; AD-617317)

Significant events in aeronautical history leading to the development of X-1 rocket powered aircraft are briefly reviewed. Early rocket research efforts of Britain, Germany, and America are discussed. Developments and experiments of Goddard, von Braun, Walter, Lippisch, and other scientists whose accomplishments were stimuli for later developments in the field of rocket propelled aircraft are summarized. A tabulation of the specifications and performance of early rocket aircraft is included. M.R.W.

N65-32862# Naval Weapons Evaluation Facility, Albuquerque, N. Mex.
THE CIRCULAR RUNWAY
Apr. 1965 38 p refs
(AD-617273)

The concept of a circular runway is examined, and the proposed advantages of such a design are discussed. It is pointed out that the design incorporates an integrated landing and approach system wherein the instrument approach flows to an infinite length runway system whose general shape is an hyperbolically sloped circular track. Depending on the approach speeds and angle of bank of the aircraft using it, the radius of the track could range from 2000 feet up to 10000 feet. Construction details are proposed, and the mathematical formulas used in developing the theory are presented. M.G.J.

N65-32938# Army Aviation Materiel Labs., Fort Eustis, Va.
EXPLORATORY DEVELOPMENT IN SUPPORT OF COMPOUND ROTARY WING AIRCRAFT Monthly Progress Report
Apr. 1965 10 p
(IR-14; AD-465012)

Preliminary results of a test program, designed to provide high speed flight data on various rotor systems, are reported. M.G.J.

N65-33169# Lockheed-California Co., Burbank.
CONTRIBUTIONS TO THE DEVELOPMENT OF A POWER SPECTRAL GUST DESIGN PROCEDURE FOR CIVIL AIRCRAFT
J. R. Fuller, L. D. Richmond, C. D. Larkins, and S. W. Russell (Boeing Co., Renton, Wash.) Jul. 1965 324 p refs
(Contract FA-WA-4768)
(Rept.-18784, Rev. 1)

Dynamic gust analysis of the Boeing Model 720B is performed and a joint probability technique for integrating power-spectral loads determination with detailed stress analysis is developed, in support of a program conducted by the Lockheed-California Company to develop a power-spectral gust design procedure for civil aircraft. The program as a whole is reported in Report FAA-ADS, "Development of a Power-Spectral Gust Design Procedure for Civil Aircraft." Author

N65-33195# Schjeldahl (G. T.) Co., Northfield, Minn.
RESEARCH AND DEVELOPMENT OF ROBIN METEOROLOGICAL ROCKET BALLOONS, VOLUME I
Bernard R. Welinski May 1963 146 p refs
(Contract AF 19(604)-8034)
(AD-463465)

A design study and testing program is presented for providing a lighter and more reliable Robin meteorological rocket balloon system. The design study includes an investigation of inflation techniques and devices, the use of lighter (25 and 35 gage) mylar, and the feasibility of using preformed mylar for sphere fabrication. Tests of experimental designs were conducted in an environmental chamber and balloons of varying design were rocket launched and tested under operational conditions. The feasibility of drape forming the spheres, using lighter (1/3 mil) film, and using a mixture of ammonia and water as an inflating gas was shown. The tests demonstrated that the gas generator separation device frequenly damaged the balloon and that a reliable inflation capsule will require further design work. Theoretical analysis and environmental chamber tests show that 20 to 30 cc of isopentane should keep the Robin inflated to 30 km. The isopentane capsule was shown to be the most reliable. C.T.C.

N65-33219# Bell Aerosystems Co., Buffalo, N. Y.
X-22A TRI-SERVICE V/STOL AIRCRAFT Monthly Progress Report No. 25, 1-31 Dec. 1964
15 Jan. 1965 39 p
(Contract NOw-63-0118-ci)
(Rept.-2127-933025; AD-463577)

In the development of the V/STOL research aircraft, manufacturing efforts were concentrated on assembling components, and on the fabrication and incorporation of required changes. Operation of the propulsion system test stand brought total development time to 24.4 hours, and installations of the reworked shafts, couplings, viscous mounts, and Beta control were completed. The stand was also stiffened to eliminate vibration at high engine speeds. Preliminary results of various quality assurance and performance tests are included. W.M.R.

N65-33352*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A FLIGHT AND SIMULATOR STUDY OF THE HANDLING QUALITIES OF A DEFLECTED SLIPSTREAM STOL SEAPLANE HAVING FOUR PROPELLERS AND BOUNDARY-LAYER CONTROL
Curt A. Holzhauser, Robert C. Innis, and Richard T. Vomaske Washington, NASA, Sep. 1965 43 p refs
(NASA-TN-D-2966) CFSTI: HC $2.00/MF $0.50 CSCL 01C

Flight and simulator tests were made to study low-speed handling qualities, potential STOL problem areas, and causes of deficiencies and their solutions. Tests of the STOL seaplane were made in the 50- to 60-knot speed range with Automatic Stabilization Equipment (ASE) engaged and disengaged. During the simulation, several stability and damping derivatives were varied and evaluated. During the flight tests, take-offs and landings were made from water at 50 knots, corresponding to a lift coefficient of about 4. With the ASE engaged, the handling characteristics of the aircraft were satisfactory. The ASE provided roll and pitch attitude stabilization and increased rate damping about these axes. With the ASE off, the handling characteristics were unsatisfactory because of low static longitudinal stability, a very unstable spiral mode, and large sideslip excursions during turn entries. Response to control inputs was satisfactory about the roll and pitch axes, but the like rotation propellers reduced the directional control to an unsatisfactory level. The simulator tests were useful in providing a preliminary evaluation and in studying the causes of deficiencies and their solutions. Good correlation was obtained between the simulator and flight results with the exception that the sideslip excursions during maneuvering were larger in flight than on the simulator. Author

N65-33391# Air Force Systems Command, Wright-Patterson AFB, Ohio. Aeronautical Systems Div.
1964 ROUGHT RIDER SUMMARY OF PARAMETERS RECORDED, TEST INSTRUMENTATION, FLIGHT OPERATIONS AND AIRCRAFT DAMAGE
Edward Miller Apr. 1965 47 p refs
(ASD-TR-65-1; AD-615749)

Various types of instrumentation were installed in a standard F-100F fighter aircraft. This aircraft was used to penetrate thunderstorms around Tinker AFB, Oklahoma and Patrick AFB, Florida. The data received from the test instrumentation was used to obtain liquid water temperature, free air temperature, altitude, airspeed; normal acceleration, vertical gust velocity and electric field intensity in and around thunderstorms. Lightning study equipment was also installed in wing and center line tanks mounted on the F-100F aircraft. This report briefly discusses the principle of operation and degree of accuracy of the above mentioned instrumentation. The report also covers flight operations, aircraft damage and a list of improvements suggested at this time as a result of studies of the recorded information. Author

N65-33482# Bell Aerosystems Co., Buffalo, N. Y.
X-22A TRI-SERVICE V/STOL AIRCRAFT Monthly Progress Report No. 22, 1–30 Sep. 1964
Sep. 1964 30 p
(Contract NOw-63-0118-ci)
(Rept.-2127-933022; AD-462011)

Continued research conducted under a program designed to develop X-22A tri-service V/STOL aircraft is reported. Engineering and design efforts were over 99% completed under the following programs: propulsion and control test stands, wind tunnel, static, and flight test. Liaison and drawing change effort continued through the fabrication and assembly phases. Propulsion system test stand fixed pitch development tests included runs with the ducts in conventional as well as hover mode. Inherent problems discovered during current tests are discussed. The wind tunnel program is in the final phase. The 1/3-scale powered duct model test exploring high speed efficiency continued. Propulsion vibration is under study and tests are continuing. Progress towards resolving vendor shortages which restrained manufacturing basic assembly fixtures and aircraft components is also reported. S.C.W.

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N65-32419* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
POWER SOURCES
R. A. Boring *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 41–47 (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

Structural environmental testing was performed on a lightweight solar thermionic system which consisted of a 5-ft diameter nickel electroformed mirror, tubular aluminum coaxial conductor–generator support, and a mockup generator. The evaluation of this engineering model has shown some design deficiencies in the components; however, preliminary analysis of the test data indicates that lightweight solar thermionic power systems can be designed to successfully meet the dynamic load requirements necessary for space flight. The system had no measurable perm-field of its own when measured at 5 ft from the geometric center of the mirror with the magnetometer on 1 milligauss full-scale range. About a 1-milligauss field was induced at 5 ft from the mirror geometric center in the plane of the concentrator. No measurable field is induced from combination parallel coaxial conductor–support arms when leads are all identical and ground loops eliminated. E.E.B.

N65-32420* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ENERGY STORAGE
R. Lutwack and G. M. Arcand *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 47–48 (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

Progress is reported on the development of a separator for the silver–zinc battery that will be capable of withstanding heat sterilization. Analysis of test results showed that the material prepared from the low-density polyethylene by precross-linking with electron beam irradiation to the 70-Mrad level followed by

grafting with acrylic acid should be considered for more extensive testing. Also, experimental results are given for the measurement of the effects of gamma radiation on the behavior of nickel and cadmium electrodes in alkali media. It is shown that irradiated cadmium electrodes lose more capacity than comparison electrodes. Also, there seems little doubt that maximum loss occurs when the electrodes are cycled about the 75%-of-charge point. Further, the data show that more material is lost from the cadmium than from the nickel. E.E.B.

N65-32422* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

SUN TRACKER CONTROL SYSTEM

T. Kerner *In its* Space Programs Sum. No. 37–33, Vol. IV 30 Jun. 1965 p 52–53 (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

A sun tracker control system is discussed. This control system is being designed to keep a parabolic mirror pointed at the Sun to within a 30-second error. The mirror drive has two degrees of freedom, one in azimuth and one in elevation. For these two axes, the two control systems that govern the motions are identical. A block diagram of the mirror control system is shown. The system has been breadboarded in the laboratory with some modifications. A diagram of the breadboard circuitry is also shown. The linear sensor is substituted by a potentiometer-generated voltage in the loop, and the gear train driving the mirror has been reduced to a typical one-stage gear train driving a potentiometer. This was done on the assumption that the inertia and the friction load of the mirror are negligible as seen by the motor and that only the first gear is significant. The system performed satisfactorily in the closed-loop configuration. E.E.B.

N65-32688# Naval Research Lab., Washington, D. C.

THEORETICAL DESIGN OF PRIMARY AND SECONDARY CELLS. PART IV: FURTHER STUDIES OF THE BATTERY DISCHARGE EQUATION

C. M. Shepherd 16 Nov. 1964 28 p refs

(NRL-6129; AD-617333)

An equation has been derived describing a complete battery discharge for the case where the current density is constant. The battery potential during discharge is given as a function of time, current density, polarization, internal resistance, and other factors. This equation has a number of practical applications. It can be used to describe battery charges, discharges, capacities, power evolution, and to predict capacities and locate errors in experimental data. A simplified numerical system has been developed for determining the equation constants from the experimental data. Author

N65-32716# Lockheed-California Co., Burbank.

SPACE ELECTRIC POWER SYSTEMS

Philip Frankel Feb. 1964 202 p refs AIAA Short Lecture Series

(LR-17558)

A series of lectures on the state-of-the-art of important space power system components and concepts is presented. A review of the basic fundamental principles is included, and the various problems and proposed methods of solutions are illustrated by reference to typical spacecrafts and missions. Emphasis was placed on the problems of batteries, hydrogen-oxygen fuel cells, and thermionic and thermoelectric power generation. Basic research on magnetohydro-dynamics (MHD), biochemical fuel cells, and the electrostatic generator is also briefly discussed. G.G.

N65-32729*# National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF THE THERMODYNAMIC PROPERTIES OF THE WORKING MEDIUM ON THE CHOICE OF OPTIMUM PARAMETERS FOR A GAS TURBINE [VLIYANIYE TERMODINAMICHESKIKH SVOYSTV RABOCHEGO TELA NA VYBOR OPTIMAL'NYKH PARAMETROV GAZOVOY TURBINY]

O. N. Yemin and N. N. Bykov Sep. 1965 14 p refs Transl. into ENGLISH from Izv. Vysshikh. Vchebn. Zavedenii, Aviats. Tekh. (Kazan), no. 2, 1965 p 65–75

(NASA-TT-F-385) CFSTI: HC $1.00/MF $0.50 CSCL 21E

Comparative criteria are discussed for deciding the optimum parameters (load factor, coefficient of discharge, flow deflection angles) of conventional hydrocarbon fuel gas turbines, as well as turbines operating on helium, hydrogen, and other working media, as a function of the thermodynamic properties of the latter. Larger values are recommended for the load factor and coefficient of discharge when the characteristic velocity of sound of the medium is high, as in the case of H and He. The problem of rectifying the exit flow from the final stage is considered; this is best achieved by limiting the load factor of the last stage or installing rectifying vanes at the exit. In either case, a penalty is paid in overall efficiency, but the second expedient is better suited to working media with a high characteristic sonic velocity. Author

N65-32871*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

COLD PERFORMANCE EVALUATION OF A 6.02-INCH RADIAL INFLOW TURBINE DESIGNED FOR A 10-KILOWATT SHAFT OUTPUT BRAYTON CYCLE SPACE POWER GENERATION SYSTEM

Milton G. Kofskey and Donald E. Holeski Washington, NASA, Sep. 1965 24 p refs

(NASA-TN-D-2987) CFSTI: HC $1.00/MF $0.50 CSCL 10A

Presented are results of a cold argon and air performance evaluation of a 6.02-inch tip diameter radial inflow turbine which was designed for space power application with argon as the working fluid. To determine turbine performance at two levels of Reynolds numbers, tests were made with argon and air at a high Reynolds number of 225 000 and in argon at a design Reynolds number of 63 700. At 225 000 Reynolds number, results indicated that the equivalent turbine performance was essentially the same using cold argon or air as the working fluid. Final tests were made in argon to establish the efficiency level at the design Reynolds number of 63 700. Results at design blade- to jet-speed ratio indicated total and static efficiencies of 0.88 and 0.83. Equivalent weight flow at design blade- to jet-speed ratio was 1.018 pounds/sec. In order to obtain an overall evaluation of turbine performance for the range of conditions investigated, design point performance data are also included. S.C.W.

N65-32894 General Motors Corp., Indianapolis, Ind. Allison Div.

LITHIUM CHLORINE ELECTROCHEMICAL ENERGY CONVERSION

D. A. J. Swinkels *In its* Allison Res. and Eng. Rept., Vol. 7, 3d Quarter 1965 1965 p 15–20 refs (See N65-32892 21-34)

The open circuit voltage and electrode polarization of the Li-Cl_2 system using fused LiCl electrolyte was investigated. The main source of polarization was found to be the mass transport of Cl_2 at the porous graphite electrode, either in the gas phase or in the electrolyte depending on the size of the pores. The porous electrode in this system differs in a fundamental way from porous electrodes in aqueous electrolytes in that molten LiCl does not wet graphite. Therefore

the thin film region at the top of the meniscus does not exist in this electrode. A quantitative model for the non-wetted porous electrode is described, and tests show fair agreement with experimental data. The limiting currents found for dead-ended electrodes appear low in terms of obtaining high power densities. However, a number of ways are cited in which the mass transport can be improved. Complete power cells were assembled using a porous electrode with excess Cl_2 flow and power densities of 6 watts/cm^3 were obtained. C.T.C.

N65-32925*# Clevite Corp., Cleveland, Ohio. Electronic Research Div.
DEVELOPMENT OF CADMIUM SULFIDE THIN FILM PHOTOVOLTAIC CELLS Third Quarterly Report, Apr. 15–Jul. 14, 1965
F. A. Shirland, J. R. Hietanen, F. Augustine, and W. K. Bower 12 Aug. 1965 61 p refs
(Contract NAS3-6461)
(NASA-CR-54641) CFSTI: HC $3.00/MF $0.75 CSCL 10A

Major accomplishments in the development of a thin CdS solar cell are reported. The output of the plastic substrate cell was brought up to the level of the metal substrate cell. Both metal and plastic substrate large area cells have averaged 5% conversion efficiency. Many of the metal and plastic substrate cells were stable for extended periods after an initial adjustment in output. Studies have disclosed no inherent instabilities for the CdS thin film solar cell. Most instabilities experienced in the past were attributed to moisture absorption or to a loosening of the collector grid. It became apparent that the present Clevite barrier formation process produces large area cells with latent efficiencies of about 7%, but incomplete collection of the current by the collector grid has prevented its realization. Changes in the conditions of cell lamination produced a number of large area cells with initial efficiencies in excess of 7%. The highest output obtained was 7.8% for a 50 cm^2 area cell with a short circuit current density of 24 mA per cm^2 and a fill factor of 70%. The highest output obtained from a plastic substrate cell was 7.1% with 22 mA per cm^2 short circuit current and a 67% fill factor. R.N.A.

N65-32943# General Electric Co., Cincinnati, Ohio.
SMALL GAS TURBINE ENGINE COMPRESSOR TECHNOLOGY Technical Progress Report, Jan. 11–Feb. 11, 1965
12 Feb. 1965 42 p
(Contract DA-44-177-AMC-180(T))
(TPR-9; AD-465646)

In the development of high pressure ratio compressor technology for small gas turbine engines, criteria are reported for selecting inlet guide vanes, rotor blades, and supersonic and subsonic stator blades. Required instrumentation and instrumentation techniques are summarized. The compressible flow entering the high speed radial outflow compressor was calculated for the original configuration using zero swirl, and a plot of the constant Mach number contours is included. The numerical method of characteristics is presented to solve the rotor blade analysis problem, and a computer program, capable of performing normal characteristic type solutions, was modified to handle rotating coordinate systems. Equations are also presented for a numerical solution to the problem of a steady-state adiabatic isentropic supersonic flow of an ideal gas in a rotating coordinate system. M.G.J.

N65-32959*# Lear Siegler, Inc., Cleveland, Ohio. Power Equipment Div.
BRUSHLESS ROTATING ELECTRICAL GENERATORS FOR SPACE AUXILIARY POWER SYSTEMS, VOLUME 5 Topical Report
J. N. Ellis and F. A. Collins 26 Apr. 1965 326 p refs
(Contract NAS3-2783)
(NASA-CR-54320) CFSTI: HC $7.00/MF $1.75 CSCL 10A

Computer programs and test data are included for two-coil and single-coil outside-coil, Lundell ac generator, for a homopolar inductor ac generator, and for a permanent magnet ac generator. Derivations, sources of formulas, and graphs are presented for pole face losses in solid-pole generators. Graphical flux analysis, the maximum $\frac{l}{d}$ ratio for rotating coil Lundell and Becky-Robinson generators, generator stator ampere loadings, and groupings of fractional slot windings are discussed. Equations are developed to describe the weights of electromagnetic parts for three generator types. Distribution, fractional slot, skew, and pitch factors are considered. Reactances per unit system system are discussed; as are the following reactances: synchronous armature reaction, transient and subtransient, negative and zero sequence, leakage, and Potier. Time constants, resistance, generator voltage and output equations, direct axis and quadratic axis components of armature reaction, and permeance calculations are also considered. M.W.R.

N65-32965*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
EFFECT OF ADDING TUNGSTEN FILLER MATERIAL TO BERYLLIA MAGNESIA THERMAL STORAGE MATERIAL IN A SOLAR THERMIONIC POWER SYSTEM
William J. Bifano and James J. Ward Washington, NASA, Sep. 1965 28 p refs
(NASA-TN-D-2978) CFSTI: HC $2.00/MF $0.50 CSCL 10A

An investigation of the effect on system specific weight of adding tungsten filler material to beryllia magnesia (3 BeO–2 MgO) thermal storage material in a solar thermionic power system is presented. A one-dimensional steady-state heat-transfer analysis is employed to determine system performance. A transient heat-transfer analysis and a discussion of thermal control requirements and variations in electrical output power during an orbit are included in the appendixes. The results indicate that the addition of tungsten to the 3 BeO–2 MgO does not lower the specific weight of the system, although small amounts may be added to relieve thermal stresses, for example, without increasing the specific weight significantly. In addition, it is found that by means of a variable generator aperture, an output power variation of less than 6 percent can be maintained through a light-dark cycle for a system designed for a maximum cavity temperature of 2200° K operating with a fixed load resistance. Author

N65-33006# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PNEUMATIC- AND HYDRAULIC-AUTOMATION
M. A. Ayzerman, ed. 30 Jun. 1965 414 p refs Transl. into ENGLISH of the book "Pnevmo- i Gidro-Avtomatika" Moscow, Izd. Nauka, 1964 264 p
(FTD-TT-65-169/1+2; AD-618061)

Application studies of pneumatic and hydraulic elements in various branches of automation are presented. Considered were relay circuits, automatic optimization systems, centralized monitoring and control systems, and remote monitoring and control systems. Emphasis was placed on the construction of pneumatic automatic devices and systems from standardized elements using a printed circuit design. Also discussed are problems of designing control machines, transducers, and converters, as well as topics in the theory and technology of hydraulic drives. G.G.

N65-33046# National Aeronautical Lab., Bangalore (India).
A NOTE ON THE FEASIBILITY OF WIND GENERATION OF ELECTRIC POWER FOR COMMUNICATION LINKS IN INDIA
S. P. Venkiteshwaran, K. R. Sivaraman, and C. G. Gupte Feb. 1965 19 p refs
(TN-WP-36-65) CFSTI: HC $1.00/MF $0.50

The power requirements of solid-state microwave radio links are very low, and could be adequately met by storage batteries charged by small wind electric generators. This would be possible at sites that are sufficiently windy to operate the generator to give a stable output. Wind electric generators in this range are not commercially available in this country at present. The paper describes a wind electric generator designed in the laboratory for this purpose. The estimates of output in watt-hours using such a generator at five stations in India have also been computed in the paper. Author

N65-33127*# Eagle-Picher Co., Joplin, Mo.
INVESTIGATIONS LEADING TO THE DEVELOPMENT OF A PRIMARY ZINC-SILVER OXIDE BATTERY OF IMPROVED PERFORMANCE CHARACTERISTICS
[1965] 48 p
(Contract NAS8-5493)
(NASA-CR-64592) CFSTI: HC $2.00/MF $0.50 CSCL 10C

Studies are being directed towards optimizing electroformation processes for the silver oxide electrode. Preliminary data have confirmed that the use of relatively high silver densities (90–110 gram/in^3) is not a suitable means of increasing the capacity of a cell. Other studies have yielded data relative to the effect of apparent density and discharge rate upon the efficiency of the spongy zinc plate. Other areas of study underway are as follows: (a) electrolyte additives; (b) effects of carbonation upon KOH electrolyte; (c) correlation of cell impedance to state-of-charge; (d) methods of recharge; (e) effects of cell tightness and volume of electrolyte upon cell performance. Author

N65-33135*# Radio Corp. of America, Mountaintop, Pa. Direct Energy Conversion Dept.
DEVELOPMENT OF IMPROVED GALLIUM ARSENIDE SOLAR CELLS Final Report, 29 Jun. 1964–28 Feb. 1965
H. W. Kuzminski et al [1965] 53 p
(Contract NAS5-9006)
(NASA-CR-64606) CFSTI: HC $3.00/MF $0.50 CSCL 10A

Diffusion tests on gallium arsenide solar cells indicate that cells must have extremely shallow diffused junction depth if conversion efficiency is to be increased. The diffusion portion could be taken care of by use of SiO_2 masking techniques; however, improvements in uniformity and crystallinity of base material are necessary to achieve reliable shallow uniform junctions. The GaAs "wrap around" solar cells which have already been fabricated can make the necessary contact. Use of an Sn-Ag and Ti-Ag contact mechanism provides a cell with low series resistance and high strength contact capable of high temperature operation. It was shown that the GaAs module, when used with this contact in conjunction with In-Ag-Pg high temperature solder, did not encounter serious problems in modularizing the cells. It was found that the junction is not physically changing and the contacts are not deteriorating during high temperature storage; and that degradation is not inherent in the cell. A decrease in parallel resistance is attributed to the formation of a low resistance shunt across the junction during high temperature storage. M.W.R.

N65-33137*# Radio Corp. of America, Lancaster, Pa. Electron Tube Div.
THE DEVELOPMENT OF A CESIUM-VAPOR-FILLED THERMIONIC ENERGY CONVERTER Final Technical Report, 18 Jun.–18 Nov. 1962
G. Y. Eastman and D. M. Ernst Dec. 1962 171 p Prepared for JPL
(Contracts NAS7-100; JPL-950229)
(NASA-CR-64614) CFSTI: HC $5.00/MF $1.00 CSCL 10A

The development, fabrication and testing of cesium-vapor-filled thermionic energy converters is presented. The units were designed for use in a solar-heated space application for the Jet Propulsion Laboratories. The geometry was limited by stringent system parameters of size and temperature. The program was directed toward the generation of twenty-five watts of output power at an emitter temperature not exceeding 2000° Kelvin. Design objectives included a service life of one year at rated capacity at an efficiency of twenty percent. RCA has delivered five converters designed to these requirements at operating temperature of less than 2000° Kelvin. The objectives of life and efficiency have been approached by incorporating materials and fabrication techniques which will obtain the greatest reliability and performance. The report covers the specific techniques, procedures and geometry of the converters shipped under the contract. In addition, details of problems encountered and their solutions are explained. Test data on converters shipped is included. Author

N65-33138*# Honeywell, Inc., Hopkins, Minn. Ordnance Div.
LOW VOLTAGE DC TO DC CONVERTER-REGULATOR WITH MINIMUM EXTERNAL MAGNETIC FIELD DISTURBANCE Final Report, 1 Jun. 1964–30 Jun. 1965
John T. Lingle and Kenneth J. Jenson [1965] 102 p ref
(Contract NAS5-3899)
(NASA-CR-64629) CFSTI: HC $4.00/MF $0.75 CSCL 10A

Work on the design, fabrication, and testing of a low voltage dc to dc converter continued. Analyses of the magnetic disturbances let to design modifications and the installation of degaussing loops. Final magnetic disturbance tests of a coaxial converter with a simple torroidal choke made of powdered permalloy showed that the magnetic disturbances were mostly within the magnetic field restraints. Modifications in the circuit improved the reliability, efficiency, and temperature stability of the device. The performance of the final converter-regulator was checked at −10° C, 25° C, and 70° C, and was found satisfactory. Efficiency increased about 3% at −10° C, and decreased about 3 percent at 70° C. This 50 watt low voltage converter-regulator weighs 5.16 pounds; further weight reductions are recommended. G.G.

N65-33176*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LOW ENERGY PROTON DAMAGE EFFECTS IN SILICON AND GALLIUM ARSENIDE SOLAR CELLS
D. M. Brown [1964] 23 p refs
(NASA-TM-X-56779) CFSTI: HC $1.00/MF $0.50 CSCL 10A

Silicon N/P cells of various base resistivities and gallium arsenide P/N solar cells were irradiated with nominally 0.6, 1.8 and 4.7 Mev protons. In the first experiment silicon N/P cells of various base resistivities and gallium arsenide cells were irradiated with 4.7 Mev proton, measuring Isc and V open as functions of flux. In the second experiment, the same types of cells were irradiated with 0.6 Mev protons, with I-V curves and spectral responses being measured. In the third experiment, a similar set of cells were irradiated with 1.8 Mev protons, with I-V curve and spectral response being measured. Author

N65-33196# Livingston Electronic Corp., Montgomeryville, Pa.
LIQUID AMMONIA BATTERIES Fourth Monthly Progress Report, Dec. 1964
15 Jan. 1965 38 p
(Contract DA-28-017-AMC-1542(A))
(Rept.-4; AD-461644)

Emphasis was placed on establishing electrical performance on a single or multiple cell basis for three liquid ammonia batteries using flat plate and wrap type cell designs. Twenty flat plate single cell tests were made using both full size cells and reduced size cells at proportionally lighter drain schedules. Wrap type cells were tested using hardware containment, but without operational activator mechanisms. Performance was generally better for the wrap type structure, but control of its overall cell thickness was not considered ideal. A full-scale fractional factorial test plan was analyzed, and oxidant materials were examined for possible increased efficiency. An "A" battery using a double height wrap cell recorded performance data for 50 hours within voltage limits at an equivalent drain rate to obtain 29000 coulombs. Evaluation of the MPR separator material showed accomplishment of electrical specifications for the "B" battery on a single cell at low temperature. Attempts to stabilize "C" battery stack performance and activation time were made. M.W.R.

N65-33221*# Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab.
EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS. ACCEPTANCE TEST OF GENERAL ELECTRIC COMPANY 5.0 AMPERE-HOUR NIMBUS CELLS
23 Jun. 1965 17 p
(NASA Order W-11252-B)
(NASA-CR-64687; QE/C-65-459) CFSTI: HC $1.00/MF $0.50
CSCL 10A

Results and procedures of acceptance tests of five ampere-hour nimbus nickel cadmium secondary spacecraft cells are given. All tests were performed at an ambient temperature between 23° C and 27° C at existing relative humidity and atmospheric pressure, and consisted of the following: phenolphthalein leak, conditioning cycle, capacity, cell short, immersion seal, overcharge, and internal resistance. All charging and discharging was done at constant current. C.T.C.

N65-33222*# Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab.
EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS. ACCEPTANCE TEST OF GULTON INDUSTRIES, INC. 6.0 AMPERE-HOUR ADHYDRODE CELLS
28 Jul. 1965 21 p
(NASA Order W-11252-B)
(NASA-CR-64617; QE/C-65-536) CFSTI: HC $1.00/MF $0.50
CSCL 10A

Results and procedures of acceptance tests of six ampere-hour adhydrode nickel cadmium secondary spacecraft cells are given. All tests were performed at an ambient temperature between 23° C and 27° C at existing relative humidity and atmospheric pressure, and consisted of the following: phenolphthalein leak, capacity, cell short, immersion seal, overcharge, and internal resistance. All charging and discharging was done at constant current. C.T.C.

N65-33245# Livingston Electronic Corp., Montgomeryville, Pa.
LIQUID AMMONIA BATTERIES Third Monthly Progress Report
15 Dec. 1964 50 p refs
(Contract DA-28-017-AMC-1542(A))
(Rept.-3; AD-462949)

Progress is reported on a program to design and develop three types of primary reserve automatically activated liquid ammonia batteries. The first scale fractional test plan was completed and analyzed with results indicating several combinations which statistically warrant further pursuit. A continuation of efforts to increase cathodic efficiency in the A battery cell lead to the development of a wrap cell geometry which resulted in an output of 1.90 watt hours per cubic inch. An attempt was made to use the wrap cell configuration in a twelve cell series package but was deferred by physical packaging problems. The first successful single cell performance after a prolonged activated stand was observed using a recently examined separator material. The performance exceeded design goals and shows promise for use in the B battery design. Improvements were made in the activator design for the A battery with respect to the ammonia transfer mechanism. Full stack cell assemblies were tested in the C battery design using single and double cathodes. Performance specifications were met at all temperature levels. R.N.A.

N65-33270# Authority Health and Safety Branch, United Kingdom Atomic Energy Authority, London (England).
RELIABILITY CONSIDERATIONS FOR AUTOMATIC PROTECTIVE SYSTEMS
A. E. Green and A. J. Bourne 1965 18 p refs
(AHSB(S)-R-91) CFSTI: HC $1.00/MF $0.50

Automatic protective systems are provided for nuclear reactors to initiate shut-down should certain specified reactor fault conditions arise. In the safety assessment of these systems, aspects of performance such as response, accuracy and efficacy are considered. However, a system analysis is never complete without giving consideration to reliability. The report discussed briefly the defjnition of reliability and indicates a method by which a reliability model for an automatic protective system may be derived on the basis of such a definition. Some applications of this simple model are described together with the corresponding limitations to its use. The general usefulness of the techniques is underlined in the context of the work of safety assessment. Author

N65-33303# Naval Ordnance Lab., White Oak, Md. Explosion Dynamics Div.
AN INVESTIGATION OF DELAY TIME VARIATION IN PRODUCTION LOADED MK 14 MOD 0 DELAY ACTUATORS
Vincent J. Menichelli Jan. 1964 27 p ref
(NOLTR-63-213; AD-423675)

Development of the Mk 14 Mod 0 Delay Actuator is presented. The delay time requirements for procurement purposes were based on development and preproduction delay time data. Initial production actuators had erratic delay times which did not meet the specification requirements. The cause for the erratic delay times was determined to be gas leakage through the phenolic initiator plug. When the leakage was corrected the actuators met the specification requirements with ease. Author

N65-33313# Radio Corp. of America, Lancaster, Pa. Direct Energy Conversion Dept.
THE DEVELOPMENT OF AN INSULATED THERMIONIC CONVERTER-HEAT PIPE ASSEMBLY
W. E. Harbaugh 30 Jun. 1965 49 p
(Contract AF 33(615)-2617)
(QTR-1; AD-468477)

This report covers the effort applied during the first three months on the subject contract toward the development of a long life insulated thermionic converter integrated with an efficient, constant temperature heat transfer device. Specifically, the cylindrical converter, RCA Type A-11988 will be adapted for heating by means of a heat pipe to operating

temperatures of 1500° C. The module available from prior work was life tested for more than 1000 hours. Irreparable damage was caused by equipment failure and the test halted. Author

N65-33317# Harry Diamond Labs., Washington, D. C.
A SUBMINIATURE MECHANICAL SAFETY AND ARMING DEVICE
Warren V. Moore 3 May 1965 21 p
(HDL-TM-65-18; AD-468853L)

A miniature safety and arming device for use in missile systems is being developed at HDL. This mechanism provides out-of-line explosive safety, acceleration-time-integrated arming, a self-destruct feature, an impact-functioning switch, and an arming-status switch. Preliminary tests on two of these devices indicate that a mechanism one-eighth the volume of a present S&A can be achieved, and with slight modification can meet the requirements of many missile systems. Author

N65-33339# Frankford Arsenal, Philadelphia, Pa. Research and Development Directorate.
PROPELLANT ACTUATED DEVICES Progress Report, Sep.–Oct. 1964
[1964] 94 p refs
(PAD-PR-96-1; AD-462951)

Progress is reported on development programs relating to propellant actuated devices. The projects reported include the design and development of thrustors, catapults, initiators, ejectors, and escape devices. Also, propellants and structural materials investigated and the feasibility studies conducted for the improvement of propellant actuated devices are included. E.E.B.

N65-33369*# Harshaw Chemical Co., Cleveland, Ohio. Crystal-Solid State Div.
RESEARCH AND DEVELOPMENT IN CdS PHOTOVOLTAIC FILM CELLS Final Report
T. A. Griffin, D. J. Krus, and J. C. Schaefer Aug. 1966 44 p refs
(Contract NAS3-4177)
(NASA-CR-54481) CFSTI: HC $2.00/MF $0.50 CSCL 10A

The report covers a one year development program to fabricate light weight, flexible, high efficiency, low cost thin film CdS solar cells capable of operating for long periods in space without appreciable degradation. Cell weight reduction and increased power output has made possible initial power to weight ratios before cell degradation, of 77 watts per pound possible. This represents a gain factor of two over the previous contract period. Increased space lifetime and cost reduction are a result of replacing electroformed grids with an electrodeposited type. Cell design and material specifications are reported. Author

N65-33414# Naval Propellant Plant, Indian Head, Md. Research and Development Dept.
THE DEVELOPMENT AND QUALIFICATION PROGRAM FOR THE ELECTROSTATICALLY INSENSITIVE X248 A6/A10 IGNITER Final Report
19 Feb. 1965 93 p
(AD-462980)

Various phases of design, testing, and fabrication of the new A6/A10 1.8 second delay X248 igniter were conducted. The squib and squib assemblies were designed and tested to meet electrostatic and ballistic requirements. Shock and vibration testing of the squib assemblies was conducted to simulate the dynamic loads expected during flight. The igniter resonance supressor paddle was modified to incorporate the squib assembly. Testing of the completed igniter consisted of subjecting all igniters to a 30 kv dc discharge at several points on the igniter to insure electrostatic insensitivity, and test firing of 10 igniters to insure ballistic reliability. The ballistic performance of the completed igniters was in conformance with all specifications and is recommended for light use in the X248 rocket motor. R.N.A.

N65-33486# Frankford Arsenal, Philadelphia, Pa. Propellant Actuated Devices Div.
PROPELLANT ACTUATED DEVICES Progress Report, Nov.–Dec. 1964
[1964] 98 p refs
(FA-PAD-97-1; AD-462783)

Progress in development programs relating to propellant actuated devices is reported. Work covered the design and development of specific devices, such as thrusters, catapults, and initiators for escape and survival systems; investigations of structural materials, and propellants for crew escape system rockets and parachutes; and feasibility studies aimed at improving the performance of propellant actuated devices and extending their application. G.G.

N65-33548*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CALORIMETRIC EVALUATION OF A 60-INCH (152-CENTIMETER) ELECTROFORMED NICKEL SOLAR CONCENTRATOR
Conrad M. Willis Washington, NASA, Sep. 1965 26 p refs
(NASA-TN-D-3012) CFSTI: HC $1.00/MF $0.50 CSCL 10B

Concentrator efficiency over a range of absorber aperture sizes has been determined for a paraboloidal solar concentrator. The concentrator was a 60° rim angle, 60-inch (152-cm) electroformed-nickel model considered suitable for use in space-vehicle power-generation systems. Testes were conducted with the concentrator mounted on a solar tracker with a water-cooled cavity calorimeter used as the heat absorber. A concentrating efficiency of 0.75 was measured at a concentration ratio of 13,300. Misorientation tests indicated small errors in lateral location of the calorimeter could be compensated by angular adjustment of the concentrator axis with respect to the sun. Author

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; protective clothing and equipment; physiological and psychological factors. For related information see also: 05 Biotechnology.

N65-32394*# National Aeronautics and Space Administration, Washington, D. C.
SPACE MEDICINE IN PROJECT MERCURY
Mae Mills Link 1965 207 p refs
(NASA-SP-4003) GPO: HC $1.00; CFSTI: MF $1.25 CSCL 6E

The NASA long-range life sciences program, pre-Mercury heritage in biotechnology, and aviation medicine are discussed in an account dealing with space medicine facets of the Mercury program. The medical aspects of astronaut selection and training are discussed, and results of laboratory tests and physiological data are included for the 31 astronaut candidates and the 7 astronauts selected. Biomedical aspects of life support systems and biomedical planning for launch, tracking, and recovery are considered. Mercury medical data are detailed; and summaries are tabulated for heart rate and respiration data from physiological monitoring, blood pressure data, pilot preflight activities, urine analyses, tilt studies, serum and plasma enzymes, blood chemistry, peripheral blood values, and fluid intake and output. The general conclusions previously drawn

about the physiological effects of space flight on man are considered to be valid in light of the accumulated medical data. M.W.R.

N65-32560 Joint Publications Research Service, Washington, D. C.
ON THE EXISTENCE OF FEEDBACK WHICH CONTROLS THE SEX RATIO
V. A. Geodakyan *In its* Probl. in Cybernetics 16 Aug. 1965 p 252-261 refs (See N65-32550 21-08) CFSTI: $7.00

An explanation of variations in the secondary sex ratio is proposed. It is shown that the relating link is the intensity of the sexual activity which on the one hand is related to the tertiary sex ratio and on the other hand to the secondary sex ratio through the hormone system. The explanation of the feedback system is of theoretical interest as an example of a control relationship from the entire population to an individual organism. It is also shown that the internal branch of the feedback mechanism is in effect basically in the male organism. An understanding of the mechanism of regulation of the secondary sex ratio gives the possibility in practical application for correct selection of the economically optimal sex ratio in a herd of farm animals. E.E.B.

N65-32561 Joint Publications Research Service, Washington, D. C.
EVOLUTION IN THE LIGHT OF CYBERNETICS
I. I. Shmal'gauzen *In its* Probl. in Cybernetics 16 Aug. 1965 p 262-266 (See N65-32550 21-08) CFSTI: $7.00

The problem of evolution of a population is discussed. A comparative evaluation of the control mechanism is offered for the individuals of a given population in a given biogenesis. In this evaluation the intra-population competition of individuals is considered. If the problem of evolution of the entire species as a whole is considered, then the control mechanism must belong to the species as a whole. In this concept the individual populations are subjected to comparative evaluation. In this case it is possible to consider intra-species competition of individuals of different populations. E.E.B.

N65-32583 Joint Publications Research Service, Washington, D. C.
THE ROLE OF THE SEXES IN TRANSMISSION AND CONVERSION OF GENETIC INFORMATION
V. A. Geodakyan *In its* Probl. in Inform. Transmission 16 Aug. 1965 p 79-88 refs (See N65-32575 21-08) CFSTI: $3.00

The role of the sexes in the evolutionary process is investigated. A new point of view is proposed for differentiation of sexes as in distinguishing the constant and operative "memory" of the type according to which females fulfill the function of constant "memory"—the tendency to be conservative—and the males, the operative memory—the tendency to be variable. The evolutionary variations of species affect the males first and then are transmitted to the females. Discovery of this specialization permits explanation of an increased death rate and excessive conception of males, greater variety in males and other phenomena related to sexual differentiation. The new approach relates sexual dimorphism with philogenetic tendencies of characteristics and gives the possibility of foreseeing the direction of change in the characteristics. Author

N65-32587 Joint Publications Research Service, Washington, D. C.
MEDICAL APPLICATION OF ULTRASOUND
Chih-Chang Hsu and Yung-Ch'ang Chou *In its* Transl. on Communist China's Sci. and Technol., No. 2/0 25 Aug. 1965 p 7-12 Transl. into ENGLISH from K'o-Hsueh Ta-chung (Peking), no. 7, 5 Jul. 1965 p 28-29 (See N65-32585 21-34) CFSTI: $2.00

The use of ultrasound, an inaudible sound with frequency above 20 000 cycles per second, as a medical diagnostic tool is described. Ultrasound signals penetrate the body and the echoes can be interpreted with an oscillograph for measurement of the thickness of internal organs and of diseased regions within the body. This technique can be used to detect or clarify conditions which elude other clinical or instrumental methods. It can be employed to detect pregnancy at 8 to 10 weeks, to reveal liver inflammations and brain tumors, and has been used to good advantage in diagnosing diseases of the eyeball, gall bladder, spleen, bladder, uterus, ovary, and in the detection of chest and abdominal fluids. J.M.D.

N65-32652 Joint Publications Research Service, Washington, D. C.
RESEARCH ON THE ROTARY RESONANCE ON ANTI-RADIATION SULPHIDE ELECTRONS
Wen-chuan Hsin, Min-jen Yao, Cheng-lien Chang, and Ch'ing-hsin Hua *In its* Transl. on Communist China's Sci. and Tech., No. 203 9 Aug. 1965 p 81-87 refs (See N65-32650 21-34) CFSTI: $5.00

Experimental results are presented for the effect of ionized radiation on rotary resonance wave spectra of electrons and the radiation protective mechanism of cysteine and other compounds. Mixtures of dry-powder-sulfide with (1) amino acid and (2) protein were dissolved in distilled water with the air removed, and vacuum dried at about 15° C to form molecular mixtures. A mixture containing gamma rays of Co^{60} was bombarded at a rate of 260 to 270 roentgens per second; total dosage for the amino acid mixture was 10^6R, for the protein 10^7R. The effect of alanine and cysteine on wave spectra of stomach protease and histidine are recorded for both molecular and physical mixtures. Similar recordings are given for the effect of cysteine on wave spectra of ku-kuang-kan-tan, which is designated as "reducing type" and discussed under the heading of hydroxy chemicals. Results indicate that molecular mixtures of hydroxy compounds offer protection to the free radicals of proteins and amino acids; derived oxides and compounds without sulfur do not exhibit the same effects. M.W.R.

N65-32658# Joint Publications Research Service, Washington, D. C.
CURRENT SOVIET STUDIES ON BIOPHYSICS
28 Jul. 1965 58 p refs Transl. into ENGLISH of 6 Articles from Biofizika (Moscow), v. 10, no. 2, 1965 p 236-245, 272-296
(JPRS-31282; TT-65-31779) CFSTI: $3.00

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N65-32659 Joint Publications Research Service, Washington, D. C.

SOME KINETIC REGULARITIES OF THE PROCESS OF ELECTRON TRANSFER DURING PHOTOSYNTHESIS

A. B. Rubin and A. S. Fokht *In its* Current Soviet Studies in Biophys. 28 Jul. 1965 p 1–10 refs (See N65-32658 21-04) CFSTI: $3.00

Reported is a study designed to determine the general behavior of the complex system of reactions involved in the sequential transport of electrons during photosynthesis. Proposed and analyzed are a system of nonlinear differential equations which describe schema of the oxidation-reduction transformations of matter in certain initial photosynthesis reactions. On the basis of derived equations the existence of a stable singular point (the stable node) on the phase plane of concentration variation was proven. Using the isocline method, the integral curves appearing at this singular point were constructed. The stationary state for a specific case was calculated and results verified the validity of the proposed scheme. S.C.W.

N65-32660 Joint Publications Research Service, Washington, D. C.

CHANGES IN FLUORESCENCE DURING THE MEASUREMENT OF DIFFERENTIAL SPECTRA OF GREEN PHOTOSYNTHESIZING BACTERIA

N. V. Karapetyan and A. A. Krasnovskiy *In its* Current Soviet Studies in Biophys. 28 Jul. 1965 p 11–16 refs (See N65-32658 21-04) CFSTI: $3.00

Differential spectra of the green bacteria *Chloropseudomonas ethylicum* were studied in the red region of the spectrum in an effort to detect bacterioviridine conversions during photosynthesis and to determine the nature of these conversions. Differential spectrophotometric techniques were used which permitted the measurement and recording of absorption to 0.1% taking place in a time of the order of 0.01 sec. Spectral curves of fluorescence variation excited by the measuring ray under intense light pulses; measured with a light filter placed near the lens; measured without the filter; measured as a function of the wavelength of the measuring light exciting the fluorescence; and measured when the intensity of the measuring light incident on the object was varied over wide limits, depending on the absorption of the object and the spectral sensitivity of the photomultiplier; are presented. S.C.W.

N65-32661 Joint Publications Research Service, Washington, D. C.

CHANGES IN ELECTRIC CHARACTERISTICS OF GIANT NEURON MEMBRANE DURING THE INCREASE OF OUTER CONCENTRATION OF POTASSIUM IONS

V. D. Gerasimov, P. G. Kostyuk, and V. A. Mayskiy *In its* Current Soviet Studies in Biophys. 28 Jul. 1965 p 17–30 refs (See N65-32658 21-04) CFSTI: $3.00

The effect of differing concentrations of potassium ions in the ambient medium on the electrical characteristics of giant neuron membranes of the grape snail was studied. Presented are data on the dependence of the transmembrane potential difference on the ambient potassium ion concentration, variation of the membrane resistance with the ambient potassium ion concentration, and characteristics of the action potential (AP) of cells depolarized by increased concentration of potassium ions. S.C.W.

N65-32662 Joint Publications Research Service, Washington, D. C.

ELECTRIC MODEL OF A NERVE FIBER. PART II: CONNECTION BETWEEN THE FUNCTIONAL PROPERTIES OF A FIBER AND ITS DIAMETER AND ION DIFFUSION IN AXOPLASMA

G. N. Berestovskiy *In its* Current Soviet Studies in Biophys. 28 Jul. 1965 p 31–42 refs (See N65-32658 21-04) CFSTI: $3.00

An electrical model of a nerve fiber with improved analogs of the external and internal fiber media is described. Using this improved version of a previous model, the role played by the protoplasm and its diffusion processes during excitation of the nerve was studied. Presented are data on the model cell with distributed storage, and data on the reaction of the cell to long-term external action. Also included are data which demonstrate the applicability of the proposed model to studies of other excited structures. S.C.W.

N65-32663 Joint Publications Research Service, Washington, D. C.

LIGHT STIMULATION OF RAIN WORM GIANT AXON

R. G. Lyudkovskaya and T. K. Pangelova *In its* Current Soviet Studies in Biophys. 28 Jul. 1965 p 43–47 refs (See N65-32658 21-04) CFSTI: $3.00

The feasibility of using monochromatic UV- and visible-light to stimulate an isolated giant axon of the rain worm was studied, and an attempt made to identify the light acceptor. Presented are data on the nature of the electrical reaction caused by light sources, and the interactions of individual regions of UV and visible light. S.C.W.

N65-32664 Joint Publications Research Service, Washington, D. C.

THE EFFECT OF A CONSTANT MAGNETIC FIELD ON PARAMECIUM MOVEMENT

A. B. Kogan and N. A. Tikhonova *In its* Current Soviet Studies in Biophys. 28 Jul. 1965 p 48–55 refs (See N65-32658 21-04) CFSTI: $3.00

The effect of a constant magnetic field on the behavior of *Paramecium caudatum* was studied on the basis of a precise index of its movement. Observed were movements in the interpolar space and near one pole of a constant magnet. Placement of a capillary between the poles of a permanent magnet changed the velocity of movement of the organism so that its dwell time at the south pole was greater than at the north. Capillary placement at either pole of a magnet showed that the recession of the organism from the south and recession from the north of the organism from the south and approach to the north poles was retarded, and the approach to the south and recession from the north were accelerated. The influence of the magnetic field on the motion of the organism developed gradually and did not disappear immediately upon removal of the field. The influence of the magnetic field also increased with an increase of field strength. It is further noted that the magnetic field may exert its influence on paramecium by changing the properties of the nutrient medium. S.C.W.

N65-32674*# Emory Univ., Atlanta, Ga.

EFFECT OF WEIGHTLESSNESS AND RADIATION ON THE GROWTH OF THE WHEAT COLEOPTILE FOR THE PURPOSE OF DEFINING AND VERIFYING AN EXPERIMENT SUITABLE FOR USE IN A BIOSATELLITE

Stephen Gray and Betty F. Edwards Washington, NASA, Sep. 1965 64 p refs

(Grant NsG-521)

(NASA-CR-303) CFSTI: HC $3.00/MF $0.75 CSCL 06C

The effects of gravity, temperature, and radiation on growth of wheat seedlings were studied experimentally. Wheat coleop-

tiles, primary roots, and secondary roots were placed in centrifuge space flight simulation chambers; they were exposed to temperatures from 21 to 29° C, x-ray irradiation up to 40 000 r, and centrifugation of 150 G for periods varying from 48 to 96 hours. Measurements of growth rate show that the optimal temperature for growth is 25° C, and that it is at that temperature that centrifugation and radiation have maximum anomolous effect; furthermore, at temperatures from 21 to 25° C the elevated gravity stimulated growth, and the 150 G force also served to reduce seedling sensitivity to radiation. J.M.D.

N65-32693# Army Biological Labs., Fort Detrick, Md.
GRAPHITIZATION OF CAST IRON AS AN ELECTRO-BIOCHEMICAL PROCESS IN ANAEROBIC SOILS
C. A. H. von Wolzogen Kühr and L. S. van der Vlugt 3 Mar. 1964 50 p refs Transl. into ENGLISH from Water (The Hague), v. 18, no. 16, 3 Aug. 1934 p 147–165 *Its* Transl. No. 1021
(FD3-3957(T-168); AD-617552)

Corrosion of cast iron in the ground was classified as to rust formation or graphitization; iron oxide being the corrosion product of the rust and iron sulfide of graphitization. The fact that extensive corrosion of iron has been observed in soils with only weak sulfate reduction, even though cast iron pipes in such soils may have a high layer of high iron sulfide content, leads to the conclusion that graphitization is not a purely chemical sulfur corrosion. Sulfate reduction in the ground was considered as a natural accumulation process, and it was concluded that this reduction serves as a depolarizer in the corrosion cell and the iron goes into the solution anodically. This anaerobic corrosion of iron was, therefore, regarded as an electro-biochemical process. Iron pipes are considered unsuitable for soils which are considered to possess chemical sulfate agressiveness. M.W.R.

N65-32709# Library of Congress, Washington, D. C. Aerospace Technology Div.
CBE FACTORS Surveys of Soviet-Bloc Scientific and Technical Literature
16 Jul. 1965 77 p refs
(ATD-B-65-43; AD-618467)

A bibliography of Soviet open source literature in the categories of aerosols, biological pathogens, and chemical substances is presented. Abstracts are included for most of the articles, all of which were published prior to 31 December 1962. M.W.R.

N65-32718*# California Univ., Los Angeles. Space Biology Lab.
RESULTS OF ELECTROENCEPHALOGRAPHIC EXAMINATIONS UNDER THE INFLUENCE OF VIBRATION AND CENTRIFUGING IN THE MONKEY
W. R. Adey, R. T. Kado, and D. O. Walter [1965] 34 p refs (Contract NAS9-1970)
(NASA-CR-65018) CFSTI: HC $2.00/MF $0.50 CSCL 06P

Effects of whole body vibration on cortical and subcortical EEG activity were tested over the range of 5 to 40 c/sec in three normal monkeys and in three monkeys who had undergone surgery six months previously for bilateral section of the vestibular nerves. Animals were blind-folded during the vibration periods. Induced EEG rhythmicity at certain frequencies had the characteristics of physiological "driving" and appeared to be distinguishable from superficially similar phenomena of artifactual origin. Autospectral density plots indicated little or no evidence of EEG driving below 9 c/sec; driving at the shaking rate was maximal between 10 to 15 c/sec; and in many instances maximum EEG energy peaks occurred at other than shaking frequencies. Shaking in the range 11 to 17 c/sec produced many coherent relationships at fundamental driving frequencies, and the bilateral section did not abolish this driving. Brief centrifuging to high G levels was followed by paroxysmal cortical and subcortical slow wave activity associated with missed cardiac beats. M.W.R.

N65-32744# Ohio State Univ. Research Foundation, Columbus.
A FURTHER STUDY OF THE INFLUENCE OF A RELEVANT BUT "UNUSED" CUE IN TRAINING UPON TRANSFER IN A POSITIVE TRANSFER SITUATION Final Report
Gordon A. Eckstrand, Alan D. Neiberg, and Ross L. Morgan Wright-Patterson AFB, Ohio, AMRL, Sep. 1964 111 p refs (Contract AF 33(038)-5474)
(AMRL-TDR-64-81; AD-607472)

This study was an attempt to assess the utility of a cue that was relevant but not used in the solution of a first task in the learning of a second task. The relationship was such that if something were learned about the relevant but "unused" cue, positive transfer would be expected to occur. In an earlier experiment, no positive transfer was found in this type of situation. The present study essentially duplicated the first but involved an important procedural modification. This modification was intended to rule out the possibility that subjects in the first study had been trained to disregard this relevant but unused cue. The findings of the present study support those of the earlier one. Even with the revised procedure, no transfer was shown from learning the first task to the learning of a second task on the basis of the cue that was originally relevant but unused. Author

N65-32754*# National Aeronautics and Space Administration, Washington, D. C.
THE USE OF INTERFERENCE CURRENTS IN THE COMBINED EXCLUSION OF PAIN IN SURGICAL OPERATIONS [DIE VERWENDUNG VON INTERFERENZSTROMEN IN DER KOMBINIERTEN SCHMERZAUSSCHALTUNG BEI CHIRURGISCHEN OPERATIONEN]
N. I. Kuzin, V. D. Zhukovskiy, and V. N. Sachkov Aug. 1965 18 p refs Transl. into ENGLISH from Acad. of Med. Sci., USSR
(NASA-TT-F-9546) CFSTI: HC $1.00/MF $0.50 CSCL 06E

Interference phenomena of two currents with similar frequency were used to obtain above-threshold narcotic effects in the deeper human organs with below-threshold current strength. A special generator for interference currents was developed and used to determine, on the eve of operations, the particular minimal strength which would just barely induce superficial analgesia in 30 patients. The observed threshold varied from 2.5 to 12 mA, and was generally higher in males than in females. Actual electronarcosis of 26 premedicated patients during various surgical procedures eliminated pain completely in 24 patients; in two patients elimination of pain was not complete at the beginning of the operation due to incorrect current strength. It was concluded that the proper choice of the narcotizing current strength is of utmost importance. Only two patients complained of muscle pains, and one person of headaches, during the postoperative period; no other complications were observed. G.G.

N65-32760# Joint Publications Research Service, Washington, D. C.
RESULTS OF EXPERIMENTAL CHECKING OF MATHEMATICAL MODELS FOR DETERMINING COMBINATIVE ABILITY
N. V. Turbin, L. A. Tarutsina, and L. V. Khatylyeva 2 Sep. 1965 14 p refs Transl. into ENGLISH from Vestsi Akad. Navuk Belarusk. SSR, Ser. Biyal. Navuk (Minsk), no. 1, 1965 p 74-81
(JPRS-31830; TT-65-32325) CFSTI: $1.00

Mathematical methods are used to determine combinative capability of parental lines in corn and to compare results of data processing with four experimental methods of interbreeding. Dial interbreeding of 7 X 7 self-fertilized corn lines,

with length of the cob the criterion, was used and the experiment was repeated five times on the basis of randomized blocks. Variance analyses are presented for the four methods. From these data it is shown that one parental line can be used successfully as a component of the syntactical quality, while another line is more valuable in specific combinative crossings. A formula is given for estimating the variance of the specific line which can be used to compare the specific combinative capabilities of a line belonging to a series of hybrids with a self-fertilized line. M.W.R.

N65-32762# Joint Publications Research Service, Washington, D. C.

SOME PRINCIPLES OF MACHINE DIAGNOSTICS

M. I. Anokhin 9 Sep. 1965 9 p Transl. into ENGLISH from the book "Methodologicheskiye Problemy Diagnostiki" Moscow, 1965 p 185–192

(JPRS-31926; TT-65-32420) CFSTI: $1.00

Discussed are mathematical logic and probability theory principles of cybernatic devices that are used for diagnostic purposes in medicine. Completely independent symptoms have a particular value in calculating disease probabilities. Diagnostic programming contains a merging of results obtained by means of deterministic logic, probability logic, phase interval logic, and simple methods. A knowledge of the etiology and the pathological mechanisms of disease is required from the doctor to interpret the external signs correctly for processing in cybernetic machines. G.G.

N65-32824# California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology

ECOLOGY OF THE NEVADA TEST SITE. III: SURVIVAL OF WINTER ANNUALS, 1963–64

Janice C. Beatley Apr. 1965 21 p refs

(Contract AT(04-1)-GEN-12)

(UCLA-12-555)

Experiments were conducted to determine the ability of winter annual species to survive from the seedling stage in ground that had been contaminated with nuclear radiation. The tests were performed in drainage basins at the Nevada Test Site during the winter of 1963–64; the ground had been subjected to radiation contamination since 1962. Over half of the plants died, but it is thought that elimination of the majority of seedlings before maturity is probably a regular phenomenon. J.M.D.

N65-32829# Oak Ridge National Lab., Tenn. Health Physics Div.

EFFECTS OF SHELL CORRECTIONS TO STOPPING POWER IN THEORETICAL DOSE STUDIES

J. E. Turner [1964] 13 p refs

(Contract W-7405-ENG-26)

(ORNL-P-659; CONF-803-2)

The theoretical evaluation of absorbed radiation dose in tissue from external sources is based on the absorbed energy and rate of linear energy transfer (LET) calculated from the Bethe stopping-power formula. For the chemical elements in tissue, it is known experimentally that shell corrections to the Bethe formula are needed for incident particle energies in the range 0 to 15 MeV. Shell correction curves that agree with experimental data for protons with a number of metals, ranging in atomic number from Be to Pb, have been developed. This work is applied to the light elements present in soft tissue. Shell correction curves, estimations of the mean excitation energies and the results of several theoretical studies based on this work are presented. Author

N65-32833# Argonne National Lab., Ill.

EFFECT OF X-RAYS AND γ-RAYS OF Co^{60} UPON THE GROWING RABBIT LARYNX: A CONTRIBUTION TO THE RB-EFFECT OF THE Co^{60} γ-RADIATION UPON THE CARTILAGE [WIRKUNG DER RONTGEN- UND DER GAMMA-STRAHLEN DES Co^{60} AUF DEN WACHSENDEN KEHLKOPE DES KANINCHENS: EIN BEITRAG ZUR RBW DER Co^{60}-GAMMA-STRAHLUNG AUF DEN KNORPEL]

Th. Hornykiewytsch Oct. 1964 5 p Transl. into ENGLISH from Biophysik (Berlin), v. 1, 1964 p 222–223

(ANL-Trans-121)

The biological effectiveness of 200 kv X-rays and γ-rays of Co^{60} upon the growing larynx (cartilage) of infantile rabbits was studied experimentally. Experimental conditions are given. After the rabbits had obtained a body weight of 2800 g from normal growth, they were sacrificed and the larynges dissected out. The radiation effect was determined by weighing of the larynx and planimetry of the cross sections of its cartilages (thyroid, arytenoid, and ring cartilage). The unit time irradiation of the infantile larynx with 500 r roentgen radiation resulted in an insignificant growth inhibition of the larynx. The strongest effect appeared after the administration of 1000 r and could not be increased to a significant extent by an increase of the radiation dose to 2000 r. After 3000 r all rabbits perished from a therapyresistant edema with consecutive suffocation. In the dose region of 500 to 3000 γr and a unit time exposure the irradiation with Co^{60} was less effective than with 200 kv X-rays. The factor for the relative biological effectiveness ($RBE_{roentgen}$) of single dose regions was determined by calculating the confrontation of the X-ray and Co^{60} radiation doses required for producing an equal decrease of the larynx weight and growth. L.S.

N65-32842# Brookhaven National Lab., Upton, N. Y. Dept. of Biology.

RADIATION DAMAGE AND RECOVERY IN MAMMALIAN CELLS

Howard J. Curtis [1964] 15 p refs

(Contract AT(30-2)-GEN-16)

(BNL-8469; Conf-801-1)

Experiments were conducted to determine why different mammalian organs have vastly different radiation sensitivities. Radiation effects at low dosages are due almost entirely to chromosomal damage, and in the mammal cell all somatic cells seem to suffer about the same chromosomal damage for equal doses. The different radiation sensitivities observed for different mammalian organs is due to recovery mechanisms within the cell which can repair a great deal of the damage over a period of days or months provided the cells are not required to undergo division. A highly differentiated cell needs only a small fraction of its total genetic complement for normal function, so the probability of a hit on a sensitive site is greatly reduced. If a cell has a large RNA pool it can function on this for a long time after vital DNA is inactivated, and while the DNA is undergoing recovery. R.N.A.

N65-32876*# National Aeronautics and Space Administration, Washington, D. C.

ABSTRACTS OF FIVE BIOMEDICAL PAPERS ON RESULTS OF SOVIET MANNED SPACE FLIGHTS

I. T. Akulinichev et al Aug. 1965 14 p Transl. into ENGLISH from Russian 14 p

(NASA-TT-F-9536) CFSTI: HC $1.00/MF $0.50 CSCL 05J

Papers dealing with cosmonaut work capacity, physical reactions of man to acceleration during space flight, and noise

normalization in life support systems in spacecraft cabins during prolonged flight are summarized. Results of some electrophysiological investigations conducted on the Voshkod I spacecraft are abstracted as are findings of a study of Chlorella cultures as a link in an ecosystem. M.W.R.

N65-32926*# Space/Defense Corp., Birmingham, Mich.
THE RESPONSE OF SQUIRREL MONKEYS TO HIGH ACCELERATIVE FORCES
John N. Mehelas and Bruce W. Pinc Washington, NASA, Jun. 1965 323 p refs
(Contract NASw-851)
(NASA-CR-236; TR64-111) CFSTI: HC $7.00/MF $1.75 CSCL 06S

Squirrel monkeys were exposed to accelerative forces from 50 G to 430 G at increments of approximately 50 G, and dwell periods ranging from 2 to 386 seconds in a centrifuge. Data recorded included clinical observations, electrocardiograms (ECG), gross pathology, and histochemical changes in tissues. From these data it was concluded that the monkey is capable of sustaining and surviving 430 G for 115.6 seconds. The pathologic response to stress differed between low, middle, and high ranges. Protection of the animal against certain aspects of stress was possible and extension of its tolerance to stress appeared feasible. Cardiac events indicated by ECG changes, included evidence of anatomical displacement under stress with severe muscle noise. Clear patterns of ischemia, myocardial infraction, and arrhythmias were seen, with tachycardia, bradycardia, and variations in amplitudes and durations of the trace elements. A mathematical hypothesis was developed which permitted calibration of the monkey to G stress at constant onset and offset rates. The hypothesis was tested successfully with many predictions regarding the lethality and non-lethality of monkey exposures. R.N.A.

N65-32928# Purdue Univ., Lafayette, Ind.
MOTIVATIONAL CORRELATES OF INDIVIDUAL DIFFERENCES IN PERFORMANCE Technical Report, May 1961–Jan. 1965
Mark W. Stephens and K. M. Michels Wright-Patterson AFB, Ohio, AMRL, May 1965 151 p refs
(Contract AF 33(616)-7962)
(AMRL-TR-39; AD-618895)

A three-year program of research was directed at the development of "paper and pencil" measurement techniques that would permit the assessment of the potential "motivatability" of subjects in experiments concerning the effects of environmental stress on human performance. A largely empirical approach was used in this research. Performance measures of a large number of subjects on several different tasks were used as the criterion measures in item analyses of several personality inventory tests. The resultant pool of cross-validated items will, it is hoped, represent a step toward increasing the precision of performance research. Author

N65-32973*# National Aeronautics and Space Administration, Washington, D. C.
DESOXYRIBONUCLEIC ACID COMPOSITION AND CERTAIN PROBLEMS IN THE EVOLUTION OF PHOTOSYNTHESIZING BACTERIA [SOSTAV DNK I NEKOTORYYE VOPROSY EVOLYUTSII FOTOSINTEZIRUYUSHCHIKH BAKTERIY]
B. F. Vanyushin, N. A. Kokurina, and A. N. Belozerskiy Sep. 1965 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 158, no. 3, 1964 p 722–725
(NASA-TT-F-316) CFSTI: HC $1.00/MF $0.50 CSCL 06M

In the interest of learning more about the evolution and species specificity of the relatively obscure autotrophic bacteria, the authors studied the nucleic acid composition of five bacterial species of the pseudomonadales order, including: one autotrophic green sulfur photosynthesizing; one purple sulfur photosynthesizing; one purple nonsulfur phototrophic; two colorless sulfur species. The taxonomic basis for the study was the nucleotide constituency of the desoxyribonucleic acid (DNA) in the micro-organisms, as well as their morphological and physiological attributes. The evidence indicates a phylogenetic relationship between the green photosynthesizing bacteria, some colorless sulfur bacteria, azotobacters, and the blue-green algae, as well as a common heredity linking these organisms. Other interrelationships, including those with certain heterotrophic species, possible common origins, and favorable directions of evolution are discussed in light of DNA structure. Author

N65-32989# Commissariat a l'Energie Atomique, Saclay (France). Departement de la Protection Sanitaire.
ANATOMO–PHYSIOLOGICAL SCHEMA OF THE GASTRO-INTESTINAL TRACT, TO BE TAKEN IN ACCOUNT IN DETERMINING THE LEVELS OF RADIOACTIVE CONTAMINATION [SCHEMA ANATOMO–PHYSIOLOGIQUE DU TRACTUS GASTRO-INTESTINAL A PRENDRE EN CONSIDERATION POUR LE CALCUL DES NIVEAUX DE CONTAMINATION RADIOACTIVE]
Claudine Fabry Mar. 1964 25 p refs In FRENCH; ENGLISH summary
(CEA-R-2413; EUR-489-f) CFSTI: HC $1.00/MF $0.50

Anatomical and physiological data of the gastrointestinal tract of adults and children were summarized in a standard schema, to be used in calculating the levels of radioactive contamination, in the food chain. Author

N65-33014# United Kingdom Atomic Energy Authority, Amersham (England). Radiochemical Centre.
MEASUREMENT OF THE SPECIFIC ACTIVITY OF RESPIRED CARBON-14 DIOXIDE AS A METHOD OF HEALTH PHYSICS CONTROL
D. A. Cook and G. H. C. Dancer May 1965 15 p refs
(RCC-R-178) CFSTI: HC $1.00/MF $0.50

A method for the measurement of the specific activity of respired carbon-14 dioxide is described. The carbon dioxide is extracted from a breath sample into sodium hydroxide solution. It can be released, when required, by the addition of an excess of lactic acid and used as the 'filling' of a proportional counter. A limiting sensitivity of 3×10^{-8} μc carbon-14 per ml carbon dioxide is obtained. Some results of measurements on persons who work in a laboratory which processes many curies of carbon-14 annually are given. They show that large quantities of this material may be handled safely in standard fume cabinets and vacuum manifold systems. Author

N65-33020# Rochester Univ., N. Y. Atomic Energy Project.
BRIEF DESCRIPTION OF MOST OF THE RESEARCH PROGRAMS COMPLETED DURING 1964 Annual Report
Henry A. Blair 9 Jan. 1965 175 p refs
(Contract W-7401-ENG-49)
(UR-668)

Radiation studies in the fields of biology and medicine were conducted to determine general radiation effects, the toxicity of radioelements, molecular and cellular levels, and chemical toxicity. Research was also conducted on radiation instruments, applications of radioisotopes, physiologic effects of radiation, and use of microwaves in radiobiologic research. The scope of the investigation, the methods used, the data resulting, and the conclusions reached are summarized for each report. M.G.J.

N65-33022# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
HANFORD RADIOLOGICAL SCIENCES RESEARCH AND DEVELOPMENT Annual Report, 1964
D. S. Pearce and J. K. Green ed. Jan. 1965 457 p refs
(BNWL-36)

Research is reported under the following subject headings: *Atmospheric Physics; Radiological Physics; Radiological Chemistry; Chemical Effluents Technology*, and *Instrumentation*. Among the studies presented are cited: precipitation scavenging studies; studies of seasonal variations of Cs^{137} in Alaskan eskimos; research on the kinetics of diffusion through human erythrocyte membranes; techniques used in the radiochemical determination of plutonium in urine; airborne-radionuclide measurements and physical characteristics determinations; studies of several adsorption, diffusion, and dispersion characteristics of anions in soils; and radiobiological-, biological-, biomedical-, dosimetry-, and atmospheric physics-instrumentation. S.C.W.

N65-33071# Joint Publications Research Service, Washington, D. C.
ADVANCES IN SPACE BIOLOGY
N. Sisakyan 13 Sep. 1965 7 p Transl. into ENGLISH from Krasnaya Zvezda (Moscow), 3 Jul. 1965 p 6
(JPRS-31954; TT-65-32448) CFSTI: $1.00

Discussions are presented on several new developments in space biology concerned with physiological effects of physical factors of the space environment such as vacuum, cosmic and solar radiation, and temperature; and the artificial spacecraft environmental factors such as pressure, gaseous composition of the atmosphere, temperature, humidity, acceleration, vibration, and weightlessness on living organisms, in particular man. R.N.A.

N65-33128*# Midwest Research Inst., Kansas City, Mo.
MEDICAL APPLICATIONS OF NASA-DEVELOPED SCIENCE AND TECHNOLOGY Quarterly Progress Report No. 2, 30 Apr.–31 Jul. 1965
R. W. Fetter, C. C. Craghead, P. L. Smith, and J. M. Brick [1965] 17 p refs
(Contract NASr-63(03); MRI Proj. 25-63-M(E))
(NASA-CR-64601) CFSTI: HC $1.00/MF $0.50 CSCL 06

Activities on a project for adapting aerospace technology to the field of medicine included continuing education of a multidisciplinary team from the medical and physical sciences, capable of recognizing potential application and adapting technology solutions to medical problems, through seminars and discussions. Other efforts included literature reviews to establish a state-of-the-art base line for evaluation of NASA technology and the definition of several problem areas in medicine where technology might readily be applied. R.N.A.

N65-33204# Joint Publications Research Service, Washington, D. C.
PROBLEMS OF THE MICROBIOLOGY OF HYDROCARBONS
N. D. Iverusalimskiy and G. K. Skryabin 17 Sep. 1965 8 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), no. 1, Jan.–Feb. 1965 p 53–57
(JPRS-32055; TT-65-32548) CFSTI: $1.00

Early research efforts in hydrocarbon utilization by microbes is reviewed, and some problems of the microbiology of hydrocarbons are described. Among cultures of Gram positive bacteria and Gram negative aerobic bacteria, none was found able to use hydrocarbons. The relationship between the taxonomic position of the microorganisms and their ability to utilize aliphatic and cyclic hydrocarbons was studied in more than 2000 cultures of mold fungi, yeasts, bacteria, and actinomycetes. Results show that members of the Penicillium, Aspergillus, Fusarium, Candida, Rhodotorula, and Torulopsis genera grew on media with liquid paraffins of the normal series as the only organic substances. W.M.R.

N65-33244# Colorado Univ., Denver. Cardiovascular Lab.
PULMONARY DIFFUSING CAPACITY IN PERSONS NATIVE TO HIGH ALTITUDE
A. C. DeGraff, Jr., R. F. Grover, J. W. Hammond, Jr., J. M. Miller, and R. L. Johnson, Jr. [1965] 30 p refs Prepared jointly with Texas Univ.
(Contract AF 41(609)-2691)
(AD-463110)

A study was conducted to measure the lung membrane diffusing capacity for carbon monoxide (D_{MCO}) in persons native to high altitudes and compare these with similar measurements in nonaltitude acclimated sea level residents. The study demonstrated that high altitude natives have significantly higher D_{MCO} than do sea level natives. The D_{MCO} of sea level natives does not increase with acclimatization to altitude. The normal relation between blood flow and lung capillary blood volume does not hold in sea level natives exercising at altitude thereby potentially causing increased nonuniformity of red cell lung capillary transit time. For the altitude studied, sea level natives reach near peak maximal oxygen consumption (MOI) after only two days at altitude, with only minor further increase in MOI occurring after four weeks at altitude. Sea level measurements of resting D_{MCO} and capillary volume closely predicted arterial saturation of subjects exercising at altitude. R.N.A.

N65-33251*# RAND Development Corp., Cleveland, Ohio.
ANALYSIS OF THE DYNAMIC SYSTEMS RESPONSE OF SOME INTERNAL HUMAN SYSTEMS
A. S. Iberall 1 Apr. 1964 146 p refs
(Contract NASw-678)
(NASA-CR-64641) CFSTI: HC $4.00/MF $1.00 CSCL 06P

Regulation and control of the human core temperature regulating system, the cardiovascular system, the hormonal system, and the behavioral system were studied from a physical point of view. It was found that all internal sub-systems in the biological system consist of limit cycle oscillators, and that the system is governed both chemically and electrically by moderating the stability of these oscillators. It is proposed that oscillator complexes in non-linear mechanics will bridge the foundational problems in Adrian neurophysiology, Freudian psychoanalysis, Pavlovian conditioned reflex concepts, Hull behaviorism, and Wiener cybernetics. G.G.

N65-33252*# Naval School of Aviation Medicine, Pensacola, Fla.
THE INFLUENCE OF VIBRATIONS ON CHROMOSOMES
James C. Knepton, Jr. 12 Apr. 1965 21 p refs Joint report with NASA
(NASA Order R-39)
(NASA-CR-64642; NSAM-924) CFSTI: HC $1.00/MF $0.50 CSCL 06F

This report gives the results of an initial series of experiments in which cells from various organisms were vibrated at frequencies of 40 and 70 cps with 10 and 20 G's. Microspores of *Tradescantia paludosa* (Clone 3 of Sax), conidia of *Neurospora crassa* (L-prolineless clock-mutant, FGSC No. 491a), *Neurospora crassa* (N.R.C. No. 865A), and ova, larvae, and pupae of *Drosophila melanogaster* (wild type) were studied for chromosomal rearrangements. No influence was found of

these vibration frequencies and accelerations on *N. crassa*, *T. paludosa*, and the P_1 generation of *D. melanogaster*, but there was observed the presence of body color and wing shape mutants among the F_1 generation of *D. melanogaster*. In future work these organisms will be subjected to other frequencies and displacements of vibration. Author

N65-33256*# Bio-Dynamics, Inc., Cambridge, Mass.
AN EVALUATION OF THE ROLE OF TRAINING IN THE SUPPRESSION OF THE MOTION SICKNESS SYNDROME: A REVIEW OF RESEARCH AND ANECDOTAL SOURCES
Arthur Taub et al 11 Jan. 1963 168 p refs
(Contract NASw-553)
(NASA-CR-64639) CFSTI: HC $5.00/MF $1.00 CSCL 06S

A summary and analysis of the effectiveness of training in suppression of motion sickness is presented. A literature review and experimental studies, relating to the vestibular physiology and motion sickness, confirmed that the motion sickness syndrome can be suppressed by means of training. Individual differences in acquiring habituation to motion are varying, and prolonged flights of future space programs may require special vestibular training procedures. The use of interoceptive conditioning techniques—as making the trainee aware of the earliest signs of motion sickness and thereby facilitating his control of suppression mechanism—is advocated as one efficient training method. This and other approaches to training should be evaluated and compared with the protection afforded by drugs. G.G.

N65-33261*# National Aeronautics and Space Administration, Washington, D. C.
CEREBRAL RHEOGRAPHY AND ITS DIAGNOSTIC POSSIBILITIES IN CLINICAL PRACTICE
A. Belluschi and V. Vacchini Aug. 1965 57 p refs Transl. into ENGLISH from Osped. Maggiore (Milan), v. 59, 1964 p 201–238
(NASA-TT-F-9497) CFSTI: HC $3.00/MF $0.50 CSCL 06E

The authors have taken up the problem of interpreting cerebral rheography. After having reported upon present knowledge on the subject, they examine the diagnostic possibilities of this knowledge and come to the conclusion that the interpretative procedure is at present entirely inadequate for furnishing data worthy of attention. Basing themselves on the hemodynamic laws which define the behavior of the cerebral flow and taking advantage of the ideas expressed in various authors' investigations using the nitrogen protoxide method, they see cerebral rheogram interpretation prospectively as an expression of the flow as a function of vascular resistance and arterial pressure. To confirm this interpretative procedure, they give numerous examples from their case histories showing an effective correspondence between the ascending limb of the rheographic wave and the vascular resistance. Author

N65-33342# Naval Medical Research Inst., Bethesda, Md.
ELEVATION OF INTERNAL BODY TEMPERATURES DURING TRANSIENT HEAT LOADS AND AT THERMAL EQUILIBRIUM
L. Copman, D. Minard, and A. R. Dasler 17 Jun. 1963 18 p refs
(Rept.-1; AD-429484)

Thermoregulatory responses of human subjects undergoing heat stress were studied utilizing a variety of environmental conditions, clothing, and work rates. Internal body temperatures were measured in the lower esophagus (t_o), ear (tympanic membrane) (t_e), and the rectum (t_r). Skin temperatures, heart rate, sweat rate, and metabolic rate were also measured. At low rates of heat storage (5 to 25 Cal/M^2hr), the rates of rise of t_o, t_e, and t_r are approximately identical. During more rapid heat storage (50 Cal/M^2hr), the rates of rise of t_o and t_e are about equal and more rapid than that of t_r. When heat storage is greater (89 to 90 Cal/M^2hr), the rate of rise of t_o is greater than that of t_e. During work in the heat in which thermal equilibrium is attained, t_o and t_e reach equilibrium considerably sooner than does t_r, and the mean increase in t_r is 20 to 40% greater than that of t_e or t_o. It is concluded that t_o and t_e are more sensitive indicators of changes in internal temperature than is t_r during transient conditions, and t_r is a more reliable index of attainment of thermal equilibrium than are t_o or t_e. Author

N65-33345# Federal Aviation Agency, Oklahoma City, Okla. Aviation Medical Service.
PRIMARY, SECONDARY, AND CALORIC NYSTAGMUS OF THE CAT FOLLOWING HABITUATION TO ROTATION
William E. Collins Jul. 1963 21 p refs
(Rept.-63-13; AD-428756)

Ten cats were exposed to a series of above-threshold accelerations and sub-threshold decelerations. Unilateral caloric irrigations, provoking nystagmus in the same direction as the above-threshold rotational stimuli preceded and followed the set of accelerations. Although neither duration nor total slow-phase eye displacement to caloric stimulation was affected, the intervening rotational experience produced some reduction in the frequency of the nystagmic beats. Two factors were proposed in explanation for the minimal transfer of adaptation from the rotational to the caloric situation. Secondary nystagmus activity was also examined and appeared closely related to preceding primary reactions. The data indicate that clinical (caloric) responses to vestibular stimulation may not give an accurate indication of a subject's state of adaptation to "practiced" levels of angular acceleration. Such findings provide cautions in the establishment of appropriate testing techniques for the analysis of vestibular function in air-or-space-vehicle crew members. Author

N65-33350*# National Aeronautics and Space Administration, Washington, D. C.
COMPUTER UTILIZATION OF TIME-LINE MEDICAL DATA FROM MAN IN SPACE FLIGHT
Jefferson F. Lindsey Sep. 1965 32 p refs
(NASA-TN-D-2695) CFSTI: HC $2.00/MF $0.50 CSCL 06S

A time-line approach was developed for a medical data computer program and involves preparing medical data on magnetic tape and on consecutive data sheets for appropriate portions of all manned space flights. Each data sheet shows all relevant information for a specified time interval, a 10 second interval during stressful periods such as exit and reentry, and a one minute interval during weightlessness. Data on each sheet includes analog and digital indicators of astronaut beat-to-beat heart rate, pulmonary ventilation, and various spacecraft environmental and astronaut performance measures. Identical types of data pertaining to each astronaut were recorded for comparable time periods for each of the six Mercury space flights and the Gemini flights to date. Selected ground based medical data were also prepared. Examples of analyses performed together with limitations are discussed. Graphical analyses, rate-of-change and rate-of-rate-of-change analyses, some computer programs for statistical analyses, and statistical model limitations are discussed. R.N.A.

N65-33364*# National Aeronautics and Space Administration, Washington, D. C.

THE APPLICATION OF MATHEMATICAL METHODS IN AVIATION AND SPACE MEDICINE, CONFERENCE, MOSCOW, FEBRUARY 25–26, 1965 Summary of Reports

K. A. Ivanov-Muromskiy et al Sep. 1965 39 p Transl. into ENGLISH of "Konf. po Primeneniyu Mat. Metodov v Aviats. i Kosmich. Med., 25–26 Fevralya 1965" Akad. Nauk SSSR (Moscow), 1965

(NASA-TT-F-374) CFSTI: HC $2.00/MF $0.50 CSCL 06E

Summaries are presented for 22 reports given at a conference dealing with the application of mathematical methods to aviation and space medicine. Subjects discussed include the use of computers for analyzing bioelectric activity of the brain, processing biomedical data, investigating control systems which include man, and for evaluating respiratory functions. The use of punch cards, a system of input devices, magnetic recordings, the application of dispersion method, and statistical indicators are considered with respect to various aeromedical problems. M.W.R.

N65-33405# Ohio State Univ., Research Foundation, Columbus.

VISUAL RECOVERY Technical Documentary Report No. 2

Norma D. Miller Brooks AFB, Tex., School of Aerospace Med., Apr. 1965 35 p refs

(Contract AF 33(657)-9229)

(SAM-TR-65-12; AD-450072)

Maximum flash-field luminances of 5.4 X 10^5 L were produced by a xenon-filled discharge tube seen by Maxwellian view. The field diameters were varied from 10° to 20 minutes of arc and the flash exposures were varied from 0.04 msec, to 1.4 msec. The maximum flash energy was 0.042 cal/cm^2 at the retina, neglecting losses in the ocular media. During most of the experimental work, the maximum flash energy was reduced to 0.012 cal/cm^2 at the retina by the use of an infrared blocking filter. The flash luminances were varied over a 30 to 1 range. The criterion measure for recovery times following the flashes was the correct identification of Sloan-Snellen test letters viewed as bright letters against a dark surround. Four letter sizes were used corresponding to 20/60 to 20/160 acuity. They were presented at various luminance levels from 130 mL to 0.03 mL. Statistical analysis of the data allowed evaluation of the effects of the flash variables. Eight color-normal subjects and one protanomalous subject participated in the experiments. The difference in the results for the protanomalous subject is described. Author

N65-33411# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

AMINO ACIDS OF THE BLOOD AT ACUTE RADIATION ILLNESS

M. Podil'chak, L. Kuzmenko et al 22 Jul. 1965 15 p refs Transl. into ENGLISH from Acta Biol. Med. Ger. (Germany), v. 12, no. 1, 1964 p 137–146

(FTD-TT-65-383/1+4; AD-467672)

The authors studied the changes of the amino acid content in the blood plasma of rabbits suffering from acute irradiation injuries. In the course of the irradiation disease, amino acids, above all lysine and cystine, are increased 2 to 3-fold, as compared to the controls. The increase of other amino acids, such as histidine, arginine, phenylalanine, methionine and valine, was less marked. At the climax of the irradiation disease, the increase of the above amino acids proved to be most obvious. At the same time, a certain lessening of tyrosine and phenylalanine was observed during the acute irradiation disease. The authors believe that the increase of most of the examined amino acids of the blood is due to a deficiency of protein and of the negative nitrogen metabolism of an irradiated organism as a result of a disintegration of proteins in certain organs and tissues, whereby a number of amino acids in the blood are increased. Author

N65-33429# Joint Publications Research Service, Washington, D. C.

STUDIES IN NEUROHUMORAL MECHANISMS OF REGULATION OF MUSCULAR ACTIVITY

M. M. Gromakovskaya 13 Sep. 1965 19 p refs Transl. into ENGLISH of the Conclusion and Table of Contents from the book "Neyro-Gumoral'n. Mekhanizmy Regulyatsii Myshechnoy Deyatel'nosti" Moscow, Acad. of Sci., 1965 p 186–201 and p 233–234

(JPRS-31968; TT-65-32462) CFSTI: $1.00

Conclusions and a bibliography are presented of a book dealing with the relationship between nervous and humoral processes and studies of neurohumoral regulation of muscular activity. Results of experiments indicate that physiologically active substances are formed in brain tissue, whether at rest or excited, and these substances enter the blood and effect neuromuscular function. The existence of humoral mechanisms participating in central nervous influences on the neuromuscular apparatus is said to be clearly revealed by disrupting the nerve connections of muscles with the CNS. Differences between vertebral canal and interperitoneal injections of serotonin and histamine upon reflex excitability of the vagus center were noted; and results obtained with rats are graphed. Serotonin and low molecular substances of organic nature are said to give brain tissue extracts their stimulating properties. M.W.R.

N65-33430# Joint Publications Research Service, Washington, D. C.

PHYSICO-CHEMICAL BASIS OF BIOELECTRIC POTENTIALS

B. N. Tarusov and A. M. Sinyukhin, ed. 13 Sep. 1965 368 p Transl. into ENGLISH of Tr. Mosk. Obshchestva Ispytatelei Prirody, Tom IX, Otd. Biol. Sekts. Biofiziki i Radiobiologii (Moscow), 5–9 Jun. 1961

(JPRS-31971; TT-65-32465) CFSTI: $7.00

Reports on cell permeability and the physico-chemical basis of the biopotentials, their origin, excitation, and flow were presented at the symposium. These included papers on cell permeability and the distribution of matter between the cell and the medium; results of studies on the mechanism of the origination of the rest and action potentials, and the relation of the biopotentials with the metabolic processes in the animal and plant organism; and discussions on questions of excitation and flow in the biophysical light. M.G.J.

N65-33459# Republic Aviation Corp., Farmingdale, N. Y. Space Environment and Life Sciences Lab.

COLLECTION AND ANALYSIS PROCEDURES FOR PHYSIOLOGICAL DATA: METHODOLOGY AND APPARATUS Final Report

J. M. Peters, Irving Axelrod, G. A. Albright Port Washington, N. Y., Naval Training Device Center, 18 May 1965 27 p

(Contract N61339-1444)

(NAVTRADEVCEN-1444-1; AD-619284)

A technique for collecting, storing and analyzing physiological data is presented with a discussion of the apparatus involved. The technique permits straightforward correlation of psychomotor with physiological data. Author

N65-33537*# Public Health Service, Cincinnati, Ohio. Div. of Environmental Engineering and Food Protection.
ECOLOGY AND THERMAL INACTIVATION OF MICROBES IN AND ON INTERPLANETARY SPACE VEHICLE COMPONENTS First Quarterly Progress Report, 1 Apr.–30 Jun. 1965
Robert Angelotti Jul. 1965 17 p refs
(NASA Order R-36-015-001)
(NASA-CR-64834) CFSTI: HC $1.00/MF $0.50 CSCL 06A

Several batches of *Bacillus globigii* spores have been produced. Several plating media were compared to determine their ability to permit germination and good outgrowth of *B. globigii* spores. Tryptone glucose extract agar was selected as the medium of choice as a result of these comparisons. Prototype models of two pieces of apparatus designed to reduce solids to particle sizes in the range of 5 to 50 microns have been developed, and their operational characteristics are being evaluated to determine their compatability with microbiological requirements. The effects of acetone, silicon carbide grinding papers and powders, and aluminum oxide grinding powders on the growth of *Bacillus globigii* spores was determined. Silicon carbide grinding paper (grit size 320) exhibited some inhibitory properties whereas similar papers of grit sizes 220 and 400 did not. No inhibition of growth was noted after storage of *B. globigii* spores in acetone for 72 hours or when they were plated in media made with water that had been used to leach silicon carbide and aluminum oxide powders. Author

N65-33542*# Texas Inst. for Rehabilitation and Research, Houston.
THE EFFECT OF BEDREST ON VARIOUS PARAMETERS OF PHYSIOLOGICAL FUNCTION. PART V: DIETARY REQUIREMENTS
M. Walters, C. Vallbona, D. Cardus, F. B. Vogt, and W. A. Spencer Washington, NASA, Sep. 1965 21 p refs
(Contract NAS9-1461)
(NASA-CR-175) CFSTI: HC $1.00/MF $0.50 CSCL 06S

This report presents data of the nutritional intake of thirteen subjects who participated in studies of the effect of short-term (3 days) and prolonged (14 days) bedrest. Two types of diets were used. One diet consisted of a 2 day cycle menu of fresh foods. The other consisted of three different menus of freeze-dried foods provided by the Food Research Division of the National Aeronautics and Space Administration. This offset the advantages of easy preparation of the freeze-dried meals and the small storage requirements of the packaged foods. The composition of the diets in terms of caloric, calcium, and nitrogen contents remained nearly constant throughout the studies. Prolonged bedrest did not produce a significant change in weight, but bedrest accompanied with isometric exercises resulted in a loss of weight in the majority of the subjects. There was no evidence of constipating effect of the low-residue diet provided by the freeze-dried foods. Author

05 BIOTECHNOLOGY

Includes life support systems, human engineering, crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N65-32679 Library of Congress, Washington, D. C. Aerospace Technology Div.
THE SECOND "MAN-IN-SPACE" SYMPOSIUM AND PROBLEMS OF VOSKHOD-2 LIFE SUPPORT SYSTEMS
Boris Mandrovsky *In its* Foreign Sci. Bull., Vol. 1, No. 8 Aug. 1965 p 21–27 refs (See N65-32675 21-34)

Information imparted by Soviet scientists in formal papers and informal discussions at this Symposium (held in Paris, 14–18 June 1965), provides an overview of the scope and diversity of their basic program in space biology, identifies new research trends and pinpoints problem areas in bioastronautics, clarifies certain misconceptions concerning procedures and equipment employed in Leonov's EVA, and indicates probable future goals of the Soviet manned spaceflight program. Author

N65-32793# General Precision, Inc., Glendale, Calif. Lab. for Automata Research.
[INTERNEURONAL TRANSFER FUNCTIONS AND FUNCTIONAL RESPONSE CHARACTERISTICS OF NERVE CELLS] Semiannual Report
E. R. Lewis et al Jan. 1964 111 p refs
(Contract AF 49(638)-1236)
(SAR-7)

Three studies concerning theoretical and electronic models of nerve cell function are reported. A preliminary report is given on a project in which electronic analog circuits are being used to explore synoptic transfer functions and to study the relationships between the functions and the modern ionic hypothesis. In an investigation of gas-ion systems operated as neurons which fire only once for each excitatory input, measurements were made of the time lag between stimulation and discharge. Initial theoretical considerations in a study of behavior in large discrete-state association systems are presented. J.M.D.

N65-33012# Indiana Univ., Bloomington.
AN INVESTIGATION OF VISION DURING INVOLUNTARY SACCADIC EYE MOVEMENTS
Robert Wesley Ebbers (M.S. Thesis) Jun. 1965 42 p refs
(Contract AF 33(608)-1070)
(AD-617409)

A study designed to determine the presence or absence of vision during involuntary saccadic eye movements is reported. Considered are involuntary movements occurring during normal steady fixation. Studied were male graduate students with 20/20 vision. It was shown that vision is present during the involuntary saccade, and that while vision is present, it is dependent in part upon stimulus intensity. Results indicate quite consistent, and large magnitude, intensity threshold differences between subject and observer. Differences were further reflected by an impairment of suprathreshold vision during the involuntary saccade, shown by blip-counting experiments and by measurements of visual acuity. This impairment was shown to be related to the optical smear of the retinal image, the greater the speed of movement of the retinal image, the greater the visual impairment. It is concluded that, contrary to findings of other investigators, vision does exist, though impaired, during involuntary saccadic eye movements, as well as during voluntary saccadic eye movements. S.C.W.

N65-33203# Joint Publications Research Service, Washington, D. C.
CHEMICAL BIONICS: HOPES AND POSSIBILITIES
A. P. Purmal' 15 Sep. 1965 18 p Transl. into ENGLISH from Khim. i Zhizn' (USSR), no. 4, 1965 p 43–52
(JPRS-32014; TT-65-32508) CFSTI: $1.00

A review of Soviet studies in chemical bionics is presented, with particular interest shown in the living cell as a chemical unit. The sustained chemical process in the living cell is proposed as an absolutely reliable control-regulation system based on chemical concentration, on which depends catalytic activity

of enzymes. The minute concentrations of enzymes required for cellular regulation and their specificity lend them to industrial application on a large scale as an example of the useful design of the cell. Various species and their specific sense abilities are included as examples of bionic applicability to modern technology. W.M.R.

N65-33289# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Bad Godesberg (West Germany). Institut für Flugmedizin.
ON THE METHODOLOGY AND PRACTICABILITY OF A PSYCHOMOTORIC TEST FOR PERFORMANCE PROGNOSES [ZUR METHODIK UND ARBEITSPROGNOSTISCHEN ANWENDUNG EINES PSYCHOMOTORISCHEN TESTVERFAHRENS]
E. Tismer Jun. 1965 52 p refs In GERMAN; ENGLISH summary
(DLR-FB-65-27; DVL-418) CFSTI: HC $3.00/MF $0.50

Methodology and practical applicability of a psychomotoric test (pellet test recorder) for performance prognoses are critically evaluated under consideration of the Lienert test efficiency criteria. Author

N65-33319# Aerospace Medical Div. Arctic Aeromedical Lab., Fort Wainwright, Alaska.
THERMAL EVALUATION OF FOOTGEAR ASSOCIATED WITH THE FULL PRESSURE HIGH ALTITUDE FLYING OUTFIT A/P 22S-2 Technical Report, 20 Nov.–9 Dec. 1963
Frederick A. Milan Jun. 1965 9 p refs
(AAL-TR-64-25; AD-469243)

Four different footgear assemblies were tested by five human subjects dressed in the A/P 22S-2 garment sitting at rest at −30° C in a temperature-controlled room. Toe temperatures were measured during the 120-minute test. These data show that after 120 minutes of exposure, mean toe temperatures of the subjects wearing the AF mukluks (N1B) and the white Vapor Barrier boots were the same (16° C). Mean toe temperatures of subjects wearing the Alert boots fell to 9° C after 120 minutes; two of the original five subjects wearing Alert boots, however, were removed from the test situation after 90 minutes because their toe temperatures fell to 2° C. The mean toe temperatures of subjects wearing a down-filled survival overboot were 20° C after 120 minutes. Author

N65-33374# Navy Electronics Lab., San Diego, Calif.
MARINE BIOLOGICAL SOUND WEST OF SAN CLEMENTE ISLAND. DIURNAL DISTRIBUTIONS AND EFFECTS ON AMBIENT NOISE LEVEL DURING JULY 1963 Research Report, Jan.–Dec. 1964
P. O. Thompson 24 May 1965 41 p refs
(NEL-1290; AD-467351)

A survey was made of the biological sound present in a set of tape recordings obtained from hydrophones at 60 and 450 fathoms, over an 8-day period. A variety of types of biological sound were distinguished and analyzed. They were shown to have significant influence on the ambient noise level. Of the variety and quantity of biological sound in the samples, eight types were found to be most prevalent. Barking and 20 c/s long pulses were present during the 192 hours monitored, at both hydrophones. An almost-continuous drone of rhythmic grunt appeared to be largely responsible for an increased base ambient noise level that occurred in the 80 c/s to 300 c/s region peaking just before midnight at the deep hydrophone. Peaks in the base ambient noise level at 2000 and 0400 hours in the 160 c/s to 1000 c/s range at the shallow hydrophone were mainly the result of increased activity of the click chorus. R.W.H.

N65-33388# Nebraska Univ., Lincoln.
A STUDY OF AIR FORCE PERSONNEL PROBLEMS ASSOCIATED WITH REMOTE OR ISOLATED ASSIGNMENTS
Jack E. Ladds 1965 118 p refs
(AD-615631)

Air Force personnel problems were studied on remote installations. Major areas considered were environmental factors, job conditions, personnel practices, career factors, and compensation. Results show that the Air Force is unable to retain its skilled and hard core technicians beyond their first enlistment. Living conditions and recreational facilities are unsuitable at remote overseas stations. The benefits derived by improving these facilities would probably be offset by savings in training costs that would accrue from a higher retention rate. This would, in turn, relieve the tedium of monotony. The proposed monthly basic pay rates fall short of raising military compensation to a level comparable to civilian and government segments of the economy. There is a need for a status symbol or recognition factor to increase prestige of men at remote sites. Efforts to develop and use selection methods as a means of minimizing adjustment problems and thus improve morale and retention of personnel assigned to isolated stations have proven only marginally successful. R.N.A.

N65-33435# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
SOME FACTORS INFLUENCING HUMAN RESPONSE TO AIRCRAFT NOISE: MASKING OF SPEECH AND VARIABILITY OF SUBJECTIVE JUDGMENTS
K. D. Kryter and C. E. Williams Jun. 1965 70 p refs
(Contract FA-64-WA-4951)
(FAA-ADS-42)

Statistics of the variability of subjective judgments of the loudness and noisiness of pure tones and complex sounds as studied in the laboratory and in the field are presented. Possible contributions to variability of judgments due to differences in the size of the external ear and the thresholds of auditory sensitivity at different sound frequencies for different age groups are discussed. Word intelligibility tests at various intensity levels were administered to a crew of trained listeners in the presence of recorded noise from jet and propeller-driven aircraft. Methods of measuring or evaluating aircraft noise predict the results of the speech tests in the following order of merit, from best to worst: (1) Articulation Index (AI); (2) and (3) perceived noise level in PNdB and Speech Interference Level (SIL) (SIL and PNdB appear to predict the masking of speech about equally well); (4) Noise Criteria (NC); (5) overall SPL, A scale; and (6) overall sound pressure level, C scale. Author

N65-33479# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
THE THRESHOLD OF VISUAL SENSATION IN COMPARISON WITH THAT OF PHOTODETECTORS, ITS QUANTUM ASPECT, PROBLEMS OF COLOR PERCEPTION, AND RELATED SUBJECTS
Radames K. H. Gebel Apr. 1964 77 p refs
(AD-611401) GPO: $1.75

The threshold of the human eye is investigated statistically, and the effective spectral quantum efficiency of the eye is compared with that of technical devices employing opto-electronic photoemissive image detection by the present state of the art. Presented are data on: the physical mechanism of vision; the spectral relationship between the lumen and quanta flux; the efficiency of the human eye in comparison with that of artificial photodetectors; lumen relationship and spectral distribution

of quanta flux of polychromatic sources: and color perception and related problems. To provide an easier comprehension of the statictical problems and limitations, conventional light flux and energy units are converted into dimensions directly expressing the number of quanta involved. Included in the text are tables, equations, and graphs. S.C.W.

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N65-32421* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

THERMAL DECOMPOSITION OF AgO AND Ag_2O

G. M. Arcand *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 48–51 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

All AgO samples were prepared in the laboratory and dried at room temperature in vacuum over P_2O_5. Pellets were prepared from the dried powder in a press such that each weighed about 1.2 gm and had a diameter of about 1.27 cm. The first pellets treated were placed loose in covered crucibles. These lost weight at the same relative rate of about 1.2×10^{-5} mg/nr. It was observed that the silver formation is essentially a surface reaction. When the pellets were clamped between Lucite plates and heated in an uncovered crucible, the rate of loss was greater. Silver metal formed on all surfaces but those in contact with the Lucite formed less metal. E.E.B.

N65-32443* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

pH INSTRUMENT DEVELOPMENT

J. R. Clark *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 172–175 (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

The approach to the measurement of hydrogen ion concentration described uses shunt voltage feedback around an operational amplifier. This type of feedback allows the pH measuring electrodes to work into a higher input impedance when the system is at null. The source resistance in series with the voltage generator is used as the equivalent circuit for the measuring electrodes. The amplifier configuration illustrated shows a mechanical chopper feeding a high-impedance field-effect transistor stage. The output of this stage drives a conventional ac amplifier. This development effort has shown that pH measurement can be accomplished using all solid-state circuitry and a mechanical chopper. E.E.B.

N65-32460* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

URINARY "FREE" CORTICOSTEROIDS BY A SIMPLE CLINICAL METHOD

A. J. Bauman *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 202–203 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

Thin-layer chromatography for the examination of urine extracts is discussed. From the analysis performed on urine extracts it was concluded that no free corticosteroids exist in urine and that clinical methods used for its determination really measure other classes of compounds. E.E.B.

N65-32452* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

THE THEORY OF THE LOW-TEMPERATURE CHROMATOGRAPHIC SEPARATION OF THE HYDROGEN ISOTOPES

J. King, Jr. and S. W. Benson *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 208–212 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

The hydrogen isotopes are separable in a variety of chromatographic columns. It is obvious from the separation of the ortho and para isotopes that there must be some type of hindered rotation on the surface since these isotopes differ only in their rotational energies. It is suggested that the hindered rotation results from the difference in the parallel and perpendicular components of the molecular polarization of the isotopes, and it is shown that the attraction of the isotopic gases to the surface arises from the electric field induced dipole interactions. E.E.B.

N65-32453* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

POLARIZATION EFFECTS IN THE CHROMATOGRAPHIC SEPARATION OF THE RARE GASES ON AN ALUMINA COLUMN

J. King, Jr. *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 212–216 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

If the retention times of the rare gases are determined under conditions of constant temperature and constant carrier gas flow, theory predicts that a plot of the logarithm of the retention time versus polarizability should yield a straight line. The resulting straight line observed from this study is convincing evidence that polarization forces are primarily responsible for the physical adsorption of gases on defect structures like alumina. This study shows a new approach in the use of gas–solid chromatography for the investigation of gas–solid interactions. Gas–solid chromatography can be used to compare electric field strengths on different adsorbants since the slope of the retention time versus polarizability plot is a function of the electric fields on the surface. Also, total interaction potential between molecules and the surface can yield information on the vibrational force constants and the intercept of the curve allows the surface area to be determined. E.E.B.

N65-32454* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

PHOTOLYSIS OF LOW CONCENTRATIONS OF NITROGEN DIOXIDE AT 3660 Å

J. King, Jr. *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 216–220 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

The photolysis of nitrogen dioxide at 3660 Å was previously studied at trace concentrations below 4×10^{-7} moles/liter. The average quantum yield for the disappearance of NO_2 was found to be 0.600 molecule/quanta. Also, previously the photolysis of NO_2 was studied at concentrations above 5×10^{-6} moles/liter. The present work was undertaken to bridge the gap between these two concentrations. Results show the quantum yield to be essentially constant over the pressure range studied. The infrared spectra of NO_2; relative quantum yields of NO_2 disappearance in photolysis at 3600 Å; and quantum yields as a function of partial pressure of NO_2 are given. The significance of the present results and those previously reported by others is discussed. E.E.B.

N65-32457* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE MICROWAVE SPECTRUM OF 2,3-DICARBAHEXABORANE(6)
R. L. Poynter and R. A. Beaudet *In its* Space Programs No. 37-33, Vol. IV 30 Jun. 1965 p 227–229 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

Frequency measurements were made of 2,3 dicarbahexaborane(6) by interpolation receiver methods using as standard frequencies the harmonics of a microwave multiplier chain which was controlled with the output signal from a quartz oscillator. The rotational constants and moments of inertia are given for six isotopic molecular species of 2,3-dicarbahexaborane(6). The final molecular structural analysis results are not available. However, preliminary results are summarized for the normal all B^{11} molecule. Bond distances and angles are omitted; however, the shift in molecular principal axes upon isotopic substitution is illustrated. It is shown that the dicarbahexaborane molecule has the form of a bipyramid with a trapezoidal base consisting of a four-membered C_2B_2 ring and two symmetrically located apex B atoms. E.E.B.

N65-32458* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DETECTION OF A SIGNAL ON A PAPER CHROMATOGRAPH
G. R. Steffensen *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 229–234 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

The use of conductivity changes to detect separations on a thin-layer chromatograph is discussed. To detect the conductivity change a pair of gold wires was placed on opposite sides of the chromatograph paper. This arrangement was treated as a resistor and placed in a bridge circuit. A lock-in amplifier tuned to 1 kc was used to generate a signal across the bridge and also to detect the signal from the bridge. The detected signal was then applied to a strip chart recorder. Operation of the system consisted of establishing a water flow down the paper and balancing the bridge. After suitable warm-up for stabilization, a 1 μliter sample was placed on the paper and its passage recorded. The sample concentration was varied and the results noted. A 10^{-4} molar test sample of $CuSO_4$ was used to determine the limiting sensitivity of the method. To detect a nonconducting compound, such as methyl alcohol, the carrier water conductivity was adjusted with NaCl. It is then possible to detect nonconducting compounds which are injected into the carrier solution. E.E.B.

N65-32476 Illinois Univ., Urbana.
PERSPECTIVES IN MATERIALS RESEARCH
Frederick Seitz *In* AGARD Advan. in Mater. Res. in the NATO Nations 1963 p 7–12 (See N65-32475 21-26) CFSTI: HC $8.35/MF $2.50

Modern technology places ever-increasing demands on the materials it needs. In the quest to meet these demands, the scientist and the engineer are constrained by limitations imposed by nature. As materials available for study increase and become subject to more careful examination by new as well as old methods, man may expect to discover completely new properties. Future developments of materials depend much less upon formal professional affiliations of the groups carrying through the work than upon the viewpoints and techniques which are used. Ultimate progress rests upon cooperation between the scientist and the engineer. M.E.L.

N65-32477 Centre de Recherches sur les Macromolecules, Strasbourg (France).
STRUCTURE AND CHARACTERIZATION OF HIGH POLYMERS IN SOLUTION [STRUCTURE ET CARACTERISATION DES HAUTS POLYMERES EN SOLUTION]
Charles Sadron *In* AGARD Advan. in Mater. Res. in the NATO Nations 1963 p 15–34 In FRENCH (See N65-32475 21-26) CFSTI: HC $8.35/MF $2.50

Very general classical and elementary considerations are given of the structure and characterization of linear high polymer chains. In the first section the problems concerning the structure and the statistics of configurations of a linear chain are briefly reviewed. In the second the principal methods of determining the molecular weight and morphological molecular parameters in a monodisperse solution of a high polymeric substance (osmotic pressure, sedimentation, viscosity, light scattering) are summarized. The last deals with the effect of polydispersity. Author

N65-32478 Fritz-Haber-Institut, Max-Planck-Gesellschaft, Berlin-Dahlem (West Germany).
STRUCTURES OF ORGANIC SOLIDS AND NEW ORGANIC POLYMERS
Rolf Hosemann *In* AGARD Advan. in Mater. Res. in the NATO Nations 1963 p 35–53 refs (See N65-32475 21-26) CFSTI: HC $8.35/MF $2.50

With the help of a refined experimental technique and generalized interference theories X-ray diffraction gives much new and direct information of the structure of high polymers. Heavy atom technique helps to analyze the atomic arrangement in crystalline proteins. Theory of paracrystals opens up the structure analysis of natural and synthetic fibres. Stretching experiments combined with small-angle scattering of polyethylene prove that fibres are a new type of solids beyond the classical concept of crystals and fluids with many new and unusual properties. Author

N65-32479 General Electric Co., Schenectady, N. Y. Research Lab.
THERMODYNAMICS AND KINETICS OF PHASE CHANGES IN SOLIDS
David Turnbull *In* AGARD Advan. in Mater. Res. in the NATO Nations 1963 p 55–64 refs (See N65-32475 21-26) CFSTI: HC $8.35/MF $2.50

The thermodynamic characteristics of phase changes and their relation to the mode of change are discussed. Phase change phenomena in solids are usually complicated and difficult to reproduce. Much of the recent achievement has consisted in the unravelling of some of these complex phenomena. One important consequence of this is that the diffusive step in precipitation processes is now fairly well understood. Some of the major remaining problems are the nature of solid–solid interfaces and the role of crystal imperfections in nucleation and in some growth processes. Author

N65-32480 Illinois Univ., Urbana. Dept. of Physics.
STATUS OF THE THEORY OF DIFFUSION IN SOLIDS
David Lazarus *In* AGARD Advan. in Mater. Res. in the NATO Nations 1963 p 65–76 refs (See N65-32475 21-26) CFSTI: HC $8.35/MF $2.50

Data are presented in the following areas: formal theory of diffusion; temperature dependence; diffusion mechanisms; impurity diffusion; diffusion in alloys; chemical, electrical, and thermal gradients; boundary and surface diffusion; semi-empirical correlations; and interactions between imperfections. It was pointed out: (1) A fuller understanding of the diffusional process appears to be vital to progress. (2) It is important that the new experimental techniques which were developed for basic studies be applied to a larger class of materials, particularly to refractory metals and alloys, intermetallic compounds, oxides, and spinels. R.W.H.

N65-32482 Chicago Univ., Ill.
SURFACE PROPERTIES
Robert Gomer *In* AGARD Advan. in Mater. Res. in the NATO Nations 1963 p 97–102 (See N65-32475 21-26) CFSTI: HC $8.35/MF $2.50

The data presented indicates that adsorption and surface reaction phenomena are electronic in nature. This is true for physical adsorption which involves a relatively mild distortion of the electron clouds of the substrate and adsorbate, and even more so for chemisorption which involves electron sharing or transfer. It was shown that the oxide-metal interface region is important in determining whether a film will be smoothly adherent. This in turn affects the overall mechanism. It was recently found that oxidation frequently leads to the formation of oxide whiskers or sheets, often growing from the base. This indicates that imperfections, either in the metal or in the oxide itself, may be important for the nucleation of oxide crystals and the mechanism of oxidation. R.W.H.

N65-32495 Central Lab. TNO, Delft (Netherlands).
THE CONVERSION OF CHEMICAL ENERGY INTO ELECTRICAL ENERGY [LA CONVERSION D'ENERGIE CHIMIQUE EN ENERGIE ELECTRIQUE]
A. J. Staverman *In* AGARD Advan. in Mater. Res. in the NATO Nations 1963 p 361–390 refs (See N65-32475 21-26) CFSTI: HC $8.35/MF $2.50

The conversion of chemical energy into electrical energy has given rise to or provides applications for new materials which may be found in various other fields. The research with respect to new materials is fundamental and applied and opens up new possibilities of fundamental research in catalysis and in electrochemistry. R.W.H.

N65-32600# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY NO. 205
12 Aug. 1965 42 p refs Transl. into ENGLISH of 2 Articles from Hua-hsueh Hsueh-pao (Peking), v. 30, no. 5, Oct. 1964 p 458–477
(JPRS-31534; TT-65-32030) CFSTI: $2.00

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1. STUDIES ON ORGANOPHOSPHORUS COMPOUNDS. I. DIALKYL p-SUBSTITUTED PHENYL- AND BENZYLPHOSPHONATES C. Y. Yuan, W.-C. Yeh, M.-C Ko, and L.-Y. Chow p 1–28 refs (See N65-32601 21-06)

2. STUDIES ON ORGANOPHOSPHORUS COMPOUNDS. II. SEPARATION OF ALKYLPHOSPHORIC ACIDS BY PAPER CHROMATOGRAPHY AND PAPER ELECTROPHORESIS H.-Y. Lu, K.-H. Yeh, and C.-Y. Yuan p 29–39 refs (See N65-32602 21-06)

N65-32601 Joint Publications Research Service, Washington, D. C.
STUDIES ON ORGANOPHOSPHORUS COMPOUNDS. I: DIALKYL p-SUBSTITUTED PHENYL- AND BENZYLPHOSPHONATES
Ch'eng-Yeh Yuan, Wei-Chen Yeh, Ming-Chuan Ko, and Li-Ying Chow *In its* Transl. on Communist China's Sci. and Technol. No. 25 12 Aug. 1965 p 1–28 refs (See N65-32600 21-06) CFSTI: $2.00

The effect of p-substituted phenylphosphonate structures on the absorption spectrum of the phosphorus-oxygen bond was studied experimentally. Lewis basicity of these structures was measured by utilizing changes in infrared spectral frequency of the oxygen-deuterium bond after association with deuterated methanol. Also, rate constants were determined in hydrolysis of p-substituted phenyl- and benzylphosphonates in concentrated alkali. J.M.D.

N65-32602 Joint Publications Research Service, Washington, D. C.
STUDIES ON ORGANOPHOSPHORUS COMPOUNDS. II: SEPARATION OF ALKYLPHOSPHORIC ACIDS BY PAPER CHROMATOGRAPHY AND PAPER ELECTROPHORESIS
Hsi-Yen Lu, Kung-Hsin Yeh, and Ch'eng-Yeh Yuan *In its* Transl. on Communist China's Sci. and Technol. No. 25 12 Aug. 1965 p 29–39 refs (See N65-32600 21-06) CFSTI: $2.00

Monoalkyl and dialkyl phosphoric acids were successfully separated both by paper chromatography and paper electrophoresis. Mobility values are listed for alkyl phosphoric acids with various numbers of carbon atoms, and a relationship between mobility value and number of carbon atoms is discussed. Paper chromatography was effective in separating monoalkyl and dialkyl phosphoric acids with the same alkyl group; paper electrophoresis appears suitable when the acids are of the same type but with different alkyl groups. J.M.D.

N65-32654 Joint Publications Research Service, Washington, D. C.
CALCULATION OF RELATIVE VOLATILITY OF DILUTE NON-ELECTROLYTE SOLUTIONS
Te-ning Wang *In its* Transl. on Communist China's Sci. and Tech., No. 203 9 Aug. 1965 p 103–112 refs (See N65-32650 21-34) CFSTI: $5.00

A simple means for calculating relative volatility of dilute polar and nonpolar halides is derived, and the gas-liquid equilibrium system of PCl_3-CCl_4 is measured to prove the equations obtained. Other systems considered are $GeCl_4$-$AsCl_3$, $SbCl_3$-$BiCl_5$, and $TiCl_4$-$SbCl_3$. Experimental values are obtained by extrapolation of large concentration values, and unlimited dilute values are used to estimate the gas-liquid diagrams of the systems. Papousik empirical law and the geometric mean value were applied in making the derivation. M.W.R.

N65-32656 Joint Publications Research Service, Washington, D. C.
THE ELECTRIC MOTIVE FORCE OF $SnCl_2$–KCl SOLUTION
Jui-wu P'eng and Shih-tsu Wen *In its* Transl. on Communist China's Sci. and Tech., No. 203 9 Aug. 1965 p 121–125 refs (See N65-32650 21-34) CFSTI: $5.00

The electromotive force for the Daniell and concentration cells and the thermodynamic properties of $SnCl_2$ solutions at low temperatures were determined. Free formed energy was found for $SnCl_2$ and $ZnCl_2$ which had been highly dehydrated with HCl. Activity of $SnCl_2$ and of an $SnCl_2$–KCl solution at 380° C is graphed. M.W.R.

N65-32657 Joint Publications Research Service, Washington, D. C.
APPLICATION OF THIN COLOR LAYERS IN INORGANIC ANALYSIS. II: SEPARATION AND DETERMINATION OF SELENIUM AND TELLURIUM
Chih-te and Ch'eng-li Liu *In its* Transl. on Communist China's Sci. and Tech., No. 203 9 Aug. 1965 p 141–145 refs (See N65-32650 21-34) CFSTI: $5.00

Positive and reverse phases of layer analysis are investigated for selenium and tellurium. When TBP-C_6H_6

which has been saturated with HCl is used as a solvent, the positive phases for Se and Te are found to have good separation, but the obtained R_f values are not stable enough. With reverse phase layer analyses, separation is good and stable R_f values are obtained. Results of layer analyses with a thiocarbomine system also indicate that the reverse phase gives better results than the positive phase. For semi-quantitative determination of Se in cathode substance, results are close to those obtained by Coulomb titration and by weight method. Semi-quantitative determination of Te is found to be best between 0.5 and 10 micrograms. M.W.R.

N65-32665# California Univ., Riverside.
PHOTOCHEMICAL AND PHOTOGALVANIC PROCESSES IN SOLUTION Final Report, 1 Mar. 1961–31 Mar. 1964
James N. Pitts, Jr., Theodore Kuwana, and Edward J. Baum
13 Jan. 1965 48 p refs
(Contract AF 19(604)-8069)
(AFCRL-65-226; AD-467093)

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1. ABSTRACT 8 p refs

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3. SOME ELECTRON SPIN RESONANCE STUDIES ON ULTRAVIOLET IRRADIATED SOLUTIONS OF ANTHRAQUINONE AND BENZOPHENONE J. H. Sharp, T. Kuwana, A. Osborne, and J. N. Pitts, Jr. 2 p refs (See N65-32667 21-06)

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6. PHOTOCHEMICAL AND ELECTROCHEMICAL STUDIES OF ORGANIC FREE RADICALS. I. PHOTOPOTENTIALS IN KETONE–ALCOHOL SYSTEMS J. N. Pitts, Jr., T. Kuwana, and A. Marchetti 12 p refs

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8. PHOTONOMETRIC TITRATION OF DISSOLVED OXYGEN AND COPPER (II) T. Kuwana 5 p refs (See N65-32671 21-06)

9. LIFETIME OF ACTIVATED PLATINUM SURFACE W. G. French and T. Kuwana 6 p refs (See N65-32672 21-06)

N65-32666 California Univ., Riverside. Dept. of Chemistry.
PARAMAGNETIC RESONANCE OF SOME BENZOPHENONE DERIVATIVES IN THEIR PHOSPHORESCENT STATE
L. H. Piette (Varian Associates), J. H. Sharp, T. Kuwana, and J. N. Pitts, Jr. *In its* Photochem. and Photogalvanic Processes in Soln. 13 Jan. 1965 2 p refs Repr. from J. Chem. phys. v. 36, no. 11, 1 Jun. 1962 p 3094–3095 (See N65-32665 21-06)
(Grant PHS-G-AP-109)

Paramagnetic resonance absorption of the triplet or phosphorescent state has been observed in several para-substituted derivatives of benzophenone. Phosphorescent states were formed during ultraviolet irradiation of the compounds in rigid solutions at liquid-nitrogen temperatures. In addition to paramagnetic absorption at $g = 4$, strong phosphorescence was exhibited by the irradiated solid solutions; the emission of 4-aminobenzophenone in ethanol at 77° K, which is presumed to arise from the triplet-singlet transition, has a maximum at 470 mμ. This phosphorescence decays exponentially with a mean lifetime of 0.41 ±0.04 sec and agrees with the decay of the paramagnetic resonance absorption signal when the light is cut off. Mean phosphorescent lifetimes of other compounds tested range from 0.2 to 0.4 sec and agree with signals at $g = 4$. M.W.R.

N65-32667 California Univ., Riverside. Dept. of Chemistry.
SOME ELECTRON SPIN RESONANCE STUDIES ON ULTRAVIOLET IRRADIATED SOLUTIONS OF ANTHRAQUINONE AND BENZOPHENONE
J. H. Sharp, T. Kuwana, A. Osborne, and J. N. Pitts, Jr. *In its* Photochem. and Photogalvanic Processes in Soln. 13 Jan. 1965 2 p refs Repr. from Chem. and Ind., 1962 p 508–510 (See N65-32665 21-06)
(Grant PHS-G-AP-109)

Free radical intermediates obtained during photochemical reduction of anthraquinone and benzophenone by electron spin resonance (ESR) methods were investigated. At room temperature the free radical anion was produced photochemically by irradiatiing a thoroughly degassed solution of 6×10^{-4} M anthraquinone in 0.2M lithium hydroxide methanol. The overall bandwidth of the ESR signal was 11.0 gauss, and definite configurational proton assignments could not be made. In neutral solutions of methanol at room temperatures the irradiation does not produce an ESR signal, but when the temperature is lowered to −190° C a broad singlet with no hyperfine structure is obtained. The signal disappears when the temperature is raised to −150° C. A benzophenone-isopropyl alcohol solution at −150° C gives a stable resonance which disappears at about −100° C. The ESR spectrum for the isopropanol radical is not observed. M.W.R.

N65-32668 California Univ., Riverside. Dept. of Chemistry.
FREE-RADICAL ADDITION TO AZOBENZENE IN CUMENE SOLUTION. ELECTRON PARAMAGNETIC RESONANCE SPECTRA OF SOME LONG-LIVED RADICAL INTERMEDIATES
J. K. S. Wan, L. D. Hess, and J. N. Pitts, Jr. *In its* Photochem. and Photogalvanic Processes in Soln. 13 Jan. 1965 2 p refs Repr. from J. of the Am. Chem. Soc., v. 86, 1964 p 2069–2070 (See N65-32665 21-06)
(Grant PHS-G-AP-00109)

A preliminary investigation indicates free-radical attack at the azo bridge and the photochemical production of a stable free radical by irradiation of an azobenzene-cumene solution in a paramagnetic resonance cavity. During irradiation at room temperature a triplet exhibiting 36 lines was observed and was attributed to the strong interaction of a nitrogen atom with an impaired electron. Larger scale experiments were also carried out, and the results obtained suggest that the excitation of azobenzene in its first absorption band can abstract a hydrogen atom from the cumene; the resulting cumene radical may add to the azo bridge to form a very stable free radical which is subsequently reduced by cumene to give N,N'-diphenyl-N-(1 methyl-1-phenylethyl) hydrazine. M.W.R.

N65-32669 California Univ., Riverside. Dept. of Chemistry.
PHOTOREDUCTION OF 2,2-DIPHENYL-1-PICRYLHYDRAZYL (DPPH) IN HYDROCARBONS

J. N. Pitts, Jr., E. A. Schuck, and J. K. S. Wan *In its* Photochem. and Photogalvanic Processes in Soln. 13 Jan. 1965 2 p refs Repr. from J. of the Am. Chem. Soc., v. 86, 1964 p 296–297 (See N65-32665 21-06)
(Grant PHS-G-AP-00109)

The photo-induced abstraction of hydrogen atoms from hydrocarbons by 2,2-diphenyl-1-picrylhydrazyl (DPPH) was accomplished at room temperature within the microwave cavity of an electron paramagnetic resonance spectrometer (EPR) with 100 kc field modulation. A typical curve indicating the disappearance of DPPH in isopropylbenzene is given; if the isopropylbenzene is impure, the EPR signal of DPPH gives a triplet spectrum instead of a quintet. Photochemical reaction of DPPH in the solid state was studied with infrared spectrometry. M.W.R.

N65-32670 California Univ., Riverside.
STRUCTURAL EFFECTS IN THE PHOTOCHEMICAL PROCESSES OF KETONES IN SOLUTION
J. N. Pitts, Jr., H. W. Johnson, Jr., and T. Kuwana *In its* Photochem. and Photogalvanic Processes in Soln. 13 Jan. 1965 6 p refs Repr. from J. Phys. Chem., v. 66, 1962 p 2456–2461 Presented at Symp. on Reversible Photochem. Processes, Durham, N. C., Apr. 1962 (See N65-32665 21-06)
(Grant PHS-G-AP-109)

Hydroxy, methoxy, amino, and chlorobenzophenones in the photopinacolization reaction were studied by product isolation, ultraviolet spectral changes, electrochemical methods, phosphorescence and fluorescence techniques, and electron spin resonance (ESR) spectroscopy. The ESR for long-lived triplets of some para-substituted benzophenones is correlated with long phosphorescent lifetimes and weak H atom abstracting power; and a tentative explanation for the phenomena is that the lowest lying triplet state in these ketones is π,π^* in nature, rather than n,π^* as in the case for benzophenone. Photchemical behavior, photopotential measurements, and approximate pinacol reductions are tabulated for the substituted benzophenones. Photochemical behavior of some substituted antiquinones is also considered. M.W.R.

N65-32671 California Univ., Riverside. Dept. of Chemistry.
PHOTONOMETRIC TITRATION OF DISSOLVED OXYGEN AND COPPER (II)
Theodore Kuwana *In its* Photochem. and Photogalvanic Processes in Soln. 13 Jan. 1965 5 p refs Repr. from Anal. Chem., v. 35, Sep. 1963 p 1398–1402 (See N65-32665 21-06)

Antraquinone was photolyzed in alkaline methanol solution to form a reducing titrant which was used for the quantitative determination of dissolved oxygen and Cu(II). The amount of oxygen and copper in the formed solution was proportional to the number of protons consumed. Variations in absorbances during photolysis are plotted at wavelengths 2950, 3250, 3950, and 4850 Å as a function of irradiation time. The methanol used as a solvent biased the solution conditions to favor deactivation by H-atom absorption. Micromole quantities of oxygen dissolved in air-saturated organic solvents of methanol, hexane, and ethyl acetate were also determined. In the presence of Cu(II), the titrant was quantitatively reduced from Cu(II) to Cu(I), and then from Cu(I) to Cu°. Quantum yield data, based on ferrioxalate actinometry, are given for the titrant system. M.W.R.

N65-32672 California Univ., Riverside. Dept. of Chemistry.
LIFETIME OF ACTIVATED PLATINUM SURFACE
William G. French and Theodore Kuwana *In its* Photochem. and Photogalvanic Processes in Soln. 13 Jan. 1965 7 p refs Repr. from J. Phys. Chem., v. 68, 1964 p 1279–1284 (See N65-32665 21-06)

Electrochemical reduction of preoxidized platinum electrodes produces a surface state exhibiting decreased activity toward the prewave of adsorbed hydrogen with time; and half-life of this activated surface state is in the order of 46 minutes. A completely deactivated electrode, which is allowed to stand in degassed solution for 12 or more hours, shows no prewave and only the normal large current due to hydrogen formation into the solution. The anodic prewave is also absent on cycling for a deactivated electrode. Ratio of coulombs for platinum oxidation to hydrogen prewave gives a value of 0.3 for activated platinum, if it is assumed that platinum oxide formation and reduction is a two-electron atom process and that adsorbed hydrogen is molecular. M.W.R.

N65-32737# Aberdeen Proving Ground, Md. Army Coating and Chemical Lab.
IDENTIFICATION OF HYDRIC COMPOUNDS BY COLOR REACTIONS Final Report
Jules B. Counts 14 Jul. 1965 8 p refs
(CCL-182; AD-618879) CFSTI: $0.75

The color reactions of a wide range of alcohols, glycols and glycol-ethers with color forming reagents in the presence of sulfuric acid have been studied. Analytical applications and limitations are discussed. Author

N65-32763# International Union of Pure and Applied Chemistry, Basle (Switzerland). Sub-Commission on Gases.
BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF GASES AND GAS-CONDENSED PHASE REACTIONS, NO. 15
L. Brewer (Calif. Univ.) 30 Jun. 1965 28 p refs

The bibliography lists 107 publications pertaining to the spectroscopy of interest to high temperature chemistry; and 144 publications of studies on the reaction between gases and condensed phases. G.G.

N65-32794# Pratt and Whitney Aircraft, Middletown, Conn.
THE VISCOSITY OF LITHIUM
D. V. Rigney, S. M. Kapelner, and R. E. Cleary Jul. 1965 16 p refs
(Contract AT(30-1)-2789)
(TIM-849)

The viscosity of lithium was determined in the temperature range from 600 to 1180 C. The results of a regression analysis of the data are given by the equation:

$$\log_{10} \eta \text{ (centipoise)} = \frac{726.07}{T\ (^\circ K)} - 1.3380$$

The activation energy required for viscous flow was determined as −3320 calories/mole over the range of investigation. Author

N65-32803# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
PROPERTIES OF PLUTONIUM DIOXIDE
J. D. Moseley and R. O. Wing 24 Aug. 1965 36 p refs
(Contract AT(29-1)-1106)
(RFP-503) CFSTI: $2.00

Selected physical and chemical properties of plutonium dioxide were investigated. Plutonium dioxide was prepared from the following plutonium salts: oxalate, nitrate, hydroxide, and peroxide. Calcination temperatures used were 240° C, 400° C, 600° C, 800° C, and 1000° C. The density, plutonium content, relative solubility, hygroscopicity, surface area, crystallite size, and thermogravimetric behavior of the oxides were measured. Author

N65-32805# Georgetown Univ., Washington, D. C. Georgetown College Observatory.
AN INVESTIGATION OF FAINT LINES IN THE SOLAR SPECTRUM FROM 6000 TO 7000 Å
Ahmad Kiasatpoor [1965] 209 p refs *Its* Monograph no. 19
(Grant NSF GP-2970)

The results of the measurement of wavelengths in the solar spectrum from 6000 to 7000 Å are reported. The spectroscopic plates were taken with the sun at low altitudes in order to intensify the spectral lines of telluric origin. The spectrograms are of the first order and were taken with a 30000 lines-per-inch concave grating which gives a reciprocal dispersion of 2.14 Å per millimeter when illuminated with parallel light rays. Approximately 6470 lines are reported for the spectral range studied. E.E.B.

N65-32826# Sandia Corp., Albuquerque, N. Mex.
ELECTRICAL CONDUCTIVITY AS A FUNCTION OF PRESSURE IN FIVE CONJUGATED AROMATIC MONOMERS
R. G. Fitzgerald Oct. 1964 8 p
(Contract AT(29-1)-789)
(SC-DC-64-1004; CONF-769-3)

The electrical conductivity of five conjugated aromatic monomers was investigated to determine the behavior of electrical conductivity as a function of pressure in organic materials, and to correlate the structure variation of a basic organic molecule with electrical conductivity during shock loading. Explosively generated pressure pulses were applied to five aromatic compounds varying in the degree of conjugation and hydrogen bonding. It was shown that the resistance of all materials at pressures of 30 to 80 kb is many orders of magnitude lower than at ambient pressure. A near metallic state is attained at 80 kb for fluorine and diaminofluorine. Conductivity is enhanced at high conjugation and hydrogen bonding. R.N.A.

N65-32834# Argonne National Lab., Ill.
$MgCl_2$-LiCl SYSTEM [SISTEMA $MgCl_2$-LiCl]
E. A. Ukshe and N. G. Bukun Oct. 1964 5 p refs Transl. into ENGLISH from Zh. Neorg. Khim. (Moscow), v. 9, 1964 p 1766–1767
(ANL-TRANS-117)

The capacity of the lead electrode in the binary system $MgCl_2$–LiCl at 720° C was determined by measurement with a method using an alternate current bridge with a frequency of 20000 gigacycles. A LiCl melt was used as a background in the reference electrode for systems with a content of LiCl above 70%, and for systems with LiCl content below 70%, $MgCl_2$ was used as the background. Curves showing the dependence of capacity on the electrode potential are shown for some of the melts. In connection with earlier data, the curves show a parabolic form with a sharp minimum, and in most cases are symmetrical. An asymmetry was observed for melts containing 3% to 15% $MgCl_2$, but the reasons for the asymmetries are not yet known. A graph is also presented showing the dependence of the minimum capacity for the lead electrode on the composition of the salt phase. The isotherm is characterized by a maximum in the region of low concentrations of $MgCl_2$ and by a smooth change of C_{min} in the residual part of the diagram. A similar character for the isotherm of the minimum capacity was established earlier for the $MgCl_2$–NaCl system. L.S.

N65-32837# Argonne National Lab., Ill.
USE OF N-BENZOYLPHENYLHYDROXYLAMINE FOR THE AMPEROMETRIC TITRATION OF TITANIUM, ZIRCONIUM, GALLIUM AND SCANDIUM [PRIMENENIE N-BENZOIL-FENILGIDROKSILAMINA DLYA AMPEROMETRICHESKOGO TITROVANIYA TITANA, TSIRKONIYA, GALLIYA I SKANDIYA]
Z. A. Gallai, I. P. Alimarin, and N. M. Sheina Nov. 1964 7 p refs Transl. into ENGLISH from Zh. Analit. Khim. (USSR), v. 18, no. 12, 1963 p 1442–1446
(ANL-Trans-129)

A method has been developed for the amperometric titration of Ti and Zr with a N-benzoylphenylhydroxylamine solution in the presence of Ni, Mn, Co, Al, Cr and Fe. A method for the amperometric titration of Ga in the presence of Al, Mn, Zn, Pb, In and Fe has been worked out. A method has been developed for the determination of Sc by back titration of the excess of N-benzolyphenylhydroxylamine with $KMnO_4$, $ZnSO_4$ and $CuSO_4$ solutions. Author

N65-32839# Battelle Memorial Inst., Columbus, Ohio.
PHASE, THERMODYNAMIC, OXIDATION, AND CORROSION STUDIES OF THE SYSTEM URANIUM–NITROGEN
Joseph Bugl and Arthur A. Bauer 4 Sep. 1964 25 p refs
(Contract W-7405-ENG-92)
(BMI-X-1692)

The pressure-temperature dependence of UN decomposition and melting, of equilibrium between the UN and U_2N_3 phases, and of nitrogen solution in the U_2N_3 phase was determined. The solubility of UN in liquid uranium was also determined. Thermodynamic functions for the formation of U_2N_3 from UN and nitrogen gas, and for the solution of nitrogen in U_2N_3 were derived. The oxidation kinetics of UN in CO_2, oxygen, and water-saturated air were found to obey the linear weight-gain law with activation energies ranging from 10400 to 15400 cal/mole. The oxidation product in atmospheric gas at temperatures of 300 deg C and greater was U_3O_8. The UN corroded in 300 deg C water to form UO_2 but the rate of corrosion was highly sensitive to stoichiometry and density. Cast, 100% dense, stoichiometric UN exhibited optimum corrosion resistance as compared with non-stoichiometric UN prepared either by casting or powder metallurgy. Corrosion rates in 100 deg C water and 820 deg C NaK were low or negligible. C.T.C.

N65-32856# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF OBTAINING THERMALLY STABLE MATERIALS
L. V. Pevzner, M. S. Akutin et al 9 Jul. 1965 5 p Transl. into ENGLISH from Russian Patent no. 136556 (Appl. no. 673003/23, 7 Jul. 1960) 2 p
(FTD-TT-65-238/1+4; AD-618009)

A method is known for obtaining thermally stable materials combining copolymers of the vinyl groups and acryl acids (after grinding on ball mills) with finely dispersed oxides or salts of the metals, 2, 3, 4, and 8 of the groups of Mendeleyev's table. On compressing the indicated compositions with a pressure of 150–200 kg/cm^2 and a temperature of 160°, there occurs a chemical reaction between the impregnated and polymeric materials (salts of acids are formed). To improve the heat resistance and mechanical strength, a method is proposed for obtaining heat-resistant materials in which there occurs the chemical union of particles with polymeric material accomplished by mechano-chemical methods. Author

N65-32858*# Yardney Electric Corp., New York.
INVESTIGATION AND IMPROVEMENT OF ZINC ELECTRODES FOR ELECTROCHEMICAL CELLS Quarterly Report No. 3, 1 Jan.–31 Mar. 1965
Z. O. J. Stachurski Jul. 1965 81 p *Its* Rept.-556-65
(Contract NAS5-3873)
(NASA-CR-64634) CFSTI: HC $3.00/MF $0.50 CSCL 07D

The rate limiting step in deposition of zinc was found to be the diffusion process, eliminating the possibility that dissociation of the zincate ion, or charge transfer, is rate limiting. Diffusion coefficient of zincate in KOH solutions up to 30% is found to be 8.5×10^{-6} cm^2/sec; at higher concentrations this coefficient falls rapidly to 1.5×10^{-6} cm^2/sec. Equations have been derived for equilibrium conditions which give separate internal concentrations of adsorbed and free zincate as a function of external solution concentration. From these equations an expression is derived for the flux of zincate through the separator. An apparatus to measure zincate flux under steady and nonsteady state conditions was placed in operation; the reduction of zincate at one face holds the zincate concentration at zero, while rotation of the membrane eliminates the boundary layer effect at the other face. It was found that the form of zinc deposited on a substrate is independent of the substrate material, and a theory is presented to account for the form of the zinc deposit. Exhaust current density for zinc in 44% KOH is found to be 0.008 A/cm^2 M.W.R.

N65-32903# Air Products and Chemicals, Inc., Allentown, Pa.
INVESTIGATION OF THE PARA-ORTHO SHIFT OF HYDROGEN Quarterly Progress Report, 1 May–1 Aug. 1964
A. H. Singleton, J. F. Kuciarka, R. G. Clark, and A. Lapin Aug. 1964 20 p refs
(Contract AF 33(615)-1316)
(QPR-1; AD-465319)

The development of a system for enhancing the para to ortho conversion rate of hydrogen is presented. The system is to be four times more efficient, on a weight basis, than the high performance catalyst developed in an earlier program. Included in this report is the planning and preliminary experimental work directed towards heterogeneous catalyst development, a discussion of the planned mechanism studies and experimental test equipment, and the activities in support of the theoretical and experimental investigation of the effect of inelastic ion-molecule collisions on the para-ortho conversion rate. Author

N65-32907# Los Alamos Scientific Lab., N. Mex.
THE SPECTROPHOTOMETRIC DETERMINATION OF PLUTONIUM AS THE ARSENAZO I COMPLEX
J. W. Dahlby and G. R. Waterbury 22 Jul. 1965 13 p refs
(Contract W-7405-ENG-36)
(LA-3314) CFSTI: $1.00

Microgram quantities of plutonium are separated from most other ions using an anion exchange resin method and are determined spectrophotometrically as the arsenazo I [3-(2-arsonophenylazo)-4, 5-dihydroxy-2, 7-naphthalenedisulfonic acid] complex in 0.4 M perchloric acid. The molar absorptivity of this complex is large, 22,000; and the method is sensitive; plutonium concentrations as small as 0.6 μg./ml. may be determined reliably by this method. Based on a total of fifty-four determinations of 8.2, 43, and 86μg. of plutonium in 10 ml. of solution, relative standard deviations of 5.8, 2.2, and 1.8%, respectively, were calculated. Of fifty foreign ions investigated, antimony, hafnium, iron, palladium, tantalum, tin, tungsten, uranium, and zirconium interfered seriously when present in fifty-fold excess. Author

N65-32914# California Univ., Berkeley Lawrence Radiation Lab.
THE ELECTRICAL, MAGNETIC, AND OPTICAL PROPERTIES OF SOME COMPLEX ORGANIC SYSTEMS
David Frederick Iiten (Ph.D. Thesis) May 1964 55 p refs
(Contract W-7405-ENG-48)
(UCRL-11374)

Donor-acceptor complexes of solutions and solids from the coronene–*p*–chloranil charge transfer complex were studied as possible model systems for photosynthesis. The charge-transfer band of crystals polarized along the needle axis formed by the line of centers joining the molecules. Photoinduced EPR signals were also observed, but an attempted correlation between heat-induced EPR signals with heat-induced changes in the electrical conductivity of perylene–*o*–chloranil crystalline complexes failed. Photoinduced EPR signals in liquid complexes established a number of systems with a rise time of less than one second. A solution of *p*–chloranil dissolved in dioxane showed a rise time for the EPR signal of approximately 30 msec. Irradiation of the complex formed between tetracyanoethylene (TCNE) and tetrahydrofuran (THF) produced a free negative TCNE ion radical. The kinetics for the formation of the TCNE negative ion radical by light were studied, and a reaction mechanism was proposed. Correlation of the data for photoinduced EPR signals with data from photoconductivity in the same TCNE-THF system produced evidence of a reversible photoinduced charge separation in the liquid system. G.G.

N65-32915# National Lead Co. of Ohio, Cincinnati.
THE DETERMINATION OF CARBON IN URANIUM AND THORIUM METAL BY THERMAL CONDUCTIVITY
J. D. Pope and J. R. Prall 30 Sep. 1964 12 p refs
(Contract AT(30-1)-1156)
(NLCO-928; CONF-790-3)

The application of the principle of thermal conductivity in the microdetermination of carbon in uranium and thorium metal is described. The method, which is rapid and simple, requires a minimum of operational training. Carbon can be determined with good precision and accuracy in the range of 50 to 5000 ppm under routine conditions, and the range has been extended to the 20 to 40 ppm level by minor modifications in operational technique. Author

N65-32920# California Univ., Berkeley. Lawrence Radiation Lab.
A CALORIMETRIC STUDY OF LIQUID GOLD–TIN ALLOYS NEAR THE COMPOSITION AuSn
Jean-Louis Daniel Guy Masse (M.S. Thesis) Aug. 1964 18 p refs
(Contract W-7405-ENG-48)
(UCRL-11581)

The relative partial molar enthalpies of gold and tin in liquid gold–tin alloys have been measured by liquid metal solution calorimetry at a temperature just above the congruent melting point of AuSn from $x_{Sn} = 0.475$ to $x_{Sn} = 0.510$. The results are represented, within a maximum scatter of ±20 cal/g atom, by two curves which do not reveal any anomalous behavior at the equiatomic composition. The data are discussed in relation to existing X-ray diffraction studies of the liquid and are compared with previous thermodynamic measurements. Author

N65-32933# California Univ., San Diego.
THE BOUNDARY CONDITIONS FOR SOME SURFACE CATALYZED REACTIONS
Paul A. Libby and Forman A. Williams [1965] 13 p refs
(Contract DA-31-124-ARO(D)-257)
(AROD-5133-6; AD-464341)

Boundary conditions for surface catalyzed reactions are developed for binary systems where the concentration of reactants and products is not vanishingly small. The implications of the steady state, and local adsorption equilibrium conditions, leading to the surface boundary conditions for diffusive flow, appear to be new. A set of surface catalyzed reactions of the form

$$\sum_{i=1}^{N} \nu_{i,j} \cdot m_i \underset{k_{b,j}}{\overset{K_{f,j}}{\rightleftharpoons}} \sum_{i=1}^{N} \nu_{i,j} \cdot m_i, \; j = 1,2,3 \ldots K$$

is considered. It is assumed that the surface on which catalysis takes place is nonporous. Both adsorption of molecules on open sites of the surface and adsorption of molecules of species i at sites already occupied by species j are considered; and the likelihood of the latter adsorption is differentiated by introducing an adsorption coefficient depending on i and j, but assuming that each open site is equally available to each species. The number of adsorption sites per unit projected area is denoted by γ_o and the surface concentrations of species i as γ_i, both in moles/cm^2 L.S.

N65-32956*# National Aeronautics and Space Administration, Washington, D. C.

SENSITIZED PHOSPHORESCENCE OF ORGANIC MOLECULES AT LOW TEMPERATURE

A. N. Terenin and V. L. Yermolayev Aug. 1965 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 85, no. 3, 1952 p 547–550

(NASA-TT-F-8759) CFSTI: HC $1.00/MF $0.50 CSCL 07D

The excitation energy transfer in mixture solutions of two fluorescent substances at liquid air temperature was investigated. Excitation of a frozen layer or solution of naphthaline alone by a filtered radiation of 3663 Å revealed no emission in the ultraviolet and visible regions. Addition of a small quantity of benzaldehyde resulted in the appearance of a characteristic visible spectrum of naphthalene phosphorescence. The growing intensity of the sensitized naphthalene phosphorescence in a mixed naphthalene + bensaldehyde solution with a constant concentration of benzaldehyde at 4×10^{-2} mole/liter was linear in nature. Increasing concentration of naphthalene to a level approximately above 10^{-2} mole/liter resulted in diminishing intensity of benzaldehyde emission. Similar effects of phosphorescence sensibilization were observed for the following pairs of substances: benzaldehyde' + dephenyl, benzophenone' + naphthalene, and benzophenone' + diphenyl. G.G.

N65-32968*# National Aeronautics and Space Administration, Washington, D. C.

ON THE DISSOLUTION OF ZINC IN ALKALIS [O RASTVORENII TSINKA V SHCHELOCHAKH]

V. I. Rodionova Sep. 1965 13 p refs Transl. into ENGLISH from Uch. Zap. Mosk. Gos. Ped. Inst. (Moscow), v. 99, 1957 p 221–226

(NASA-TT-F-252) CFSTI: HC $1.00/MF $0.50 CSCL 07D

The relationship between the dissolution of zinc and the nature of the alkalis and the concentration of their solutions was investigated. The corrosion rate of zinc depends on the nature of the alkali cation. In all the alkalis investigated, the dependence of the corrosion rate of zinc on the alkali concentration is almost identical. In dilute solutions of alkalis, the corrosion rate of zinc increases with increasing concentration of the aggressive medium, reaching a maximum in one normal solution of potassium hydroxide and lithium hydroxide and in a 3N solution of sodium hydroxide. In medium concentrations of alkalis, the corrosion rate of zinc remains constant and does not depend on the ion concentration of the aggressive medium. In concentrated solutions of most alkalis, the corrosion rate decreases somewhat. The described dependence of the corrosion rate of zinc on the alkali concentration is explained by the character of the surface compounds that arise during the reaction of zinc with alkali, their composition, structure, properties, and ability to persist on the surface of the metal. The coating film passivating action is confirmed by experiments on the mixing of the alkali solutions. R.N.A.

N65-32972*# National Aeronautics and Space Administration, Washington, D. C.

EXTENSION OF THE CHAMPMAN-ENSKOG METHOD TO GAS MIXTURES WITH INTERNAL DEGREES OF FREEDOM AND CHEMICAL REACTIONS [RASPROSTRANENIYE METODA CHEPMENA-ENSKOGA NA SMESI GASOV S VNUTRENNIMI STEPENYAMI SVOBODY I KHIMICHESKIMI REAKTSIYAMI]

S. V. Vallander, I. A. Yegorova, and M. A. Rydalevskaya Sep. 1965 13 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Mat., Mekh. i Astron. (Leningrad), v. 19, no. 7, 1964 p 155–161

(NASA-TT-F-311) CFSTI: HC $1.00/MF $0.50 CSCL 07D

The conclusions set forth in the present study provide a generalization of the Chapman-Enskog Method; this generalization makes it possible to study gas mixtures with internal degrees of freedom and chemical reactions. The study differs from works which have been published recently in two ways: (1) A study is made of gas mixtures in which chemical exchange reactions can occur (i.e., when two particles collide, two and only two particles are produced); (2) A different system of macroscopic parameters is selected, by which the distribution functions are represented in this connection, new macroscopic equations for determining these parameters are developed.

Author

N65-32977# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

ISOTOPIC ANALYSIS USING OPTICAL SPECTROSCOPY [ANALYSE ISOTOPIQUE PAR SPECTROSCOPIE OPTIQUE]

S. Gerstenkorn 1963 40 p refs In FRENCH; ENGLISH summary

(CEA-2301) CFSTI: HC $2.00/MF $0.50

The isotopic displacement in the atomic lines of certain elements (H, He, Li, Ne, Sr, Hg, Pb, U, Pu) is used for dosing these elements isotopically. The use of the Fabry-Perot photoelectric interference spectrometer is shown to be particularly adapted for this sort of problem: in each case we give on the one hand the essential results obtained with this apparatus, and on the other hand the results previously obtained with a conventional apparatus (grating, photographic plate). These results together give an idea of the possibilities of optical spectroscopy: in the best case, the precision which may be expected is of the order of 1 to 2 percent for isotopes whose concentration is about 1 percent. Author

N65-32982# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

CHLORINE TRIFLUORIDE [LE TRIFLUORURE DE CHLORE]

L. M. Vincent and J. Gillardeau 1963 95 p refs In FRENCH; ENGLISH summary

(CEA-2360) CFSTI: HC $3.00/MF $0.75

This monograph on chlorine trifluoride may be considered as a working tool useful in gaseous diffusion research. It consists of data gathered from the literature and includes furthermore a certain amount of original data. This monograph groups together the physical, chemical and physiological properties of chlorine trifluoride, as well as the preparation

and analytical methods. It has been thought wise to add some technological information, and the safety regulations governing its use. Author

N65-32984# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.

CONTRIBUTION TO THE ACTIVATION ANALYSIS OF THE RARE GASES. CONTRIBUTION TO THE ANALYSIS OF CARBON MONOXIDE AND WATER VAPOUR IN GASES [CONTRIBUTION A L'ANALYSE PAR ACTIVATION DES GAZ RARES. CONTRIBUTION A L'ANALYSE DE L'OXYDE DE CARBONE ET DE LA VAPEUR D'EAU DANS LES GAZ]

Jean Diebolt (Ph.D. Thesis—Grenoble Univ.) [1964] 46 p refs In FRENCH; ENGLISH summary

(CEA-R-2357) CFSTI: HC $2.00/MF $0.50

In the present work, we have applied radio-active analysis to the general technique of rare gas separation. This separation is carried out on active charcoal, at constant pressure. The desorption of the gas is caused by an increase in the initial temperature of adsorption. These separations are quantitative and can be confirmed by chemical analysis. The volumes of desorbed gas are measured by radio-active counting. We have also used radio-activation to study the reduction of palladous chloride by carbon monoxide. Since this reduction is quantitative, we can have a knowledge of the mass of palladium reduced by measuring its activity. We have used the property which have organic chlorides of being hydrolysed by water vapour and of liberating hydrochloric acid to study quantitatively the amount of water vapour which a gas contains. The hydrochloric acid formed is measured by activation of the chlorine in the acid. Author

N65-32987# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

PREPARATION OF THIN CARBON FILMS [PREPARATION DE COUCHES MINCES DE CARBONE]

M. Gillois 1963 21 p In FRENCH; ENGLISH summary

(CEA-2390) CFSTI: HC $1.00/MF $0.50

Carbon deposits have been prepared on silica glass supports in order to determine more accurately than by weighing the losses liable to occur during oxidation, for example under irradiation in the presence of CO_2. Several processes have been studied with a view to obtaining deposits for which the variation in optical density as a function of carbon departure shall be reproducible for each sample. Among the methods used, the most satisfactory is that in which the pyrolitic carbon deposited on a carbon filament is evaporated; however only the samples prepared simultaneously exhibit the required identical behaviour. The carbonaceous deposits have been studied by micro-electronic diffraction. An examination of the photographs shows the presence of graphite monocrystals of about $(30\ \mu)^2$. Author

N65-32993# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

CONTRIBUTION TO THE STUDY OF THE OXIDATION OF COBALT AND ITS PROTOXIDE IN AIR AT HIGH TEMPERATURES [CONTRIBUTION A L'ETUDE DE L'OXYDATION DU COBALT ET DE SON PROTOXYDE DANS L'AIR AUX TEMPERATURES ELEVEES]

Marie-Geneviève Vallee (Ph.D. Thesis, Paris Univ.) 1964 116 p refs In FRENCH ENGLISH summary

(CEA-R-2424) CFSTI: HC $4.00/MF $0.75

The surface oxidation process of cobalt in air follows a parabolic law and is characterized between 750 and 1350° C by an activation energy of 41,000 cals/mole. Between 400 and 900° C the oxide film is made up of two layers: CoO next to the metal and Co_3O_4 on the surface. Above 900° C only CoO remains. The morphological properties of these films have been studied; growth anistropy, crystallization facies, oxide grain growth, texture, nucleation of Co_3O_4 on a CoO base round about 900° C. The oxidation of cobalt protoxide between 700 and 910° C results in the building up, on the outside surface of CoO discs, of a usually continuous layer of Co_3O_4. Under certain conditions this surface reaction is accompanied by a reaction along the longitudinal symmetry plane of the sample where a layer of Co_3O_4 of very irregular thickness builds up. Author

N65-32996# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

ELECTROLYTIC DISSOCIATION OF NH_2 IN LIQUID AMMONIA [DISSOCIATION ELECTROLYTIQUE DE NH_2 K DANS NH_3 LIQUIDE]

Fernande Botter Aug. 1964 25 p refs In FRENCH; ENGLISH summary

(CEA-R-2435) CFSTI: HC $1.00/MF $0.50

By assuming the DEBYE and HUCKEL approximation giving the activity coefficient and the ONSAGER relationship linking the conductivity and infinite dilution conductivity of an electrolyte, it has been possible using the available literature data and the electrical conductivity measurements carried out for this purpose, to calculate certain typical parameters of the dissociation of potassium amide in liquid ammonia in the temperature range of −77° C to −33.5° C: degree of dissociation, mean activity coefficient of the ions NH_2^- and K^+, and the mean activity of these ions. Author

N65-32997# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

STUDY OF THE USE OF AN ELECTRIC DISCHARGE FOR HOLLOW CATHODES USED AS OPTICAL EXCITATION SOURCES IN THE SPECTROGRAPHIC MEASUREMENT OF FLUORINE IN THORIUM, URANIUM AND PLUTONIUM [ETUDE DE L'UTILISATION DE LA DECHARGE ELECTRIQUE EN CATHODE CREUSE COMME SOURCE D'EXCITATION OPTIQUE POUR LE DOSAGE SPECTROGRAPHIQUE DU FLUOR DANS LE THORIUM, L'URANIUM ET LE PLUTONIUM]

Michel Buffereau, Gerard Crehange, and Josette Poublan Aug. 1964 92 p refs In FRENCH; ENGLISH summary

(CEA-R-2436) CFSTI: HC $3.00/MF $0.75

Experimental studies of the optimal conditions for spectrographic quantitative analysis of fluorine in metals and oxides by means of electrical discharge in helium or neon atmospheres are reported. The hollow cathode lamps used under both hot and cold conditions for the analysis are described. Transl. by J.M.D.

N65-32998# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

CONTRIBUTION TO THE THERMODYNAMIC STUDY OF THE NON-STOICHIOMETRIC OXIDES UO_{2+x} AND FeO_{1+x} [CONTRIBUTION A L'ETUDE THERMODYNAMIQUE DES OXYDES NON STOECHIOMETRIQUES UO_{2+x} ET FeO_{1+x}]

Paul Gerdanian (Ph.D. Thesis, Paris Univ.) 1964 66 p refs In FRENCH; ENGLISH summary

(CEA-R-2438) CFSTI: HC $3.00/MF $0.75

This thermodynamic study has provided new results concerning the oxide UO_{2+x} and FeO_{1+x}. For the oxides UO_{2+x} correct values have been obtained for $\mu_{O_2}^M$ at 900°, 1000° and 1100° C using an improved method based on physicochemical equilibria. For the oxides FeO_{1+x} the use of an E. Calvet high temperature calorimeter has made it possible to

measure for the first time the values of h $\frac{M}{O_2}$ at 800° C over the whole iron monoxide range. The method of oxygen transfer between oxides, usually used to determine the phase limits, has been improved by using a thermobalance; this has made it possible to draw up simple rules which have to be respected in order to detect the phenomena under study. The theory due to J. S. ANDERSON has been applied to the oxides UO_{2+x} and a new method is given for improving the representation of non-stoichiometric oxides by models. Author

N65-33007# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ORGANOSILICON DERIVATIVES OF DICYCLOPENTADIENYL IRON
Guan-Lee Wu 7 Jul. 1965 24 p refs Transl. into ENGLISH from Huaxue Tongbao (China), no. 5, 1963 p 293–301
(FTD-TT-64-1345/1+2+3+4; AD-618007)

A variety of organosilicon derivates of dicyclopentadienyl iron are described. The two basic methods of derivation constituted introduction of a silanyl substituting group to the nucleus of dicyclopentadienyl iron with the formation of mono- and di-substituted derivatives, or to obtain the silicon containing derivatives of dicyclopentadiene first, then metallizing them with RMgX, RNa, and RLi and subsequent condensation with $FeCl_2$. G.G.

N65-33025# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
DETERMINATION OF THE ABSOLUTE CONCENTRATIONS OF H_2O-D_2O MIXTURES USING THE INCREASE IN SENSITIVITY OF INFRA-RED ABSORPTION MEASUREMENTS [DETERMINATION DU TITRE ABSOLU DES MELANGES H_2O-D_2O PAR AUGMENTATION DE LA SENSIBILITE DES MESURES PAR ABSORPTION INFRA-ROUGE]
Maurice Ceccaldi 1964 15 p refs In FRENCH; ENGLISH summary
(CEA-R-2441) CFSTI: HC $1.00/MF $0.50

A description is given in this report of original work concerning an infrared method for determining the absolute isotopic content of H_2O-D_2O mixtures. The spectrum is obtained, in both the liquid and the solid states, of water of unknown D_2O content and of mixtures of this water and light water. The Beer-Lambert law is well followed in this case; the measurement of three parameters involved in this law is described together with a method of measuring the fourth parameter. The results obtained using infrared and nuclear resonance techniques are compared. The concentration of the 99.99 60 percent reference water is known with a precision of at least +40 ppm −20 ppm and very likely to ±5 ppm. Author

N65-33036# Commissariat a l'Energie Atomique, Fontenay-aux Roses (France). Centre d'Etudes Nucleaires.
THE REPROCESSING OF IRRADIATED FUELS IMPROVEMENT AND EXTENSION OF THE SOLVENT EXTRACTION PROCESS [LE TRAITEMENT DES COMBUSTIBLES IRRADIES AMELIORATION ET EXTENSION DU PROCEDE UTILISANT LES SOLVANTS]
Pierre Faugeras and André Chesne 1964 17 p refs In FRENCH; ENGLISH summary
(CEA-R-2668) CFSTI: HC $1.00/MF $0.50

Improvements made in the conventional tri-butylphosphate process are described, in particular: the concentration and the purification of plutonium by one extraction cycle using tri-butyl-phosphate with reflux; and the use of an apparatus working continuously for precipitating plutonium oxalate, for calcining the oxalate, and for fluorinating the oxide. The modifications proposed for treatment of irradiated uranium-molybdenum alloys are described, in particular, the dissolution of the fuel, and the concentration of the fission product solutions. The solvent extraction treatment is used also for the plutonium fuels utilized for the fast breeder reactor (Rapsodie). An outline of the process is presented and discussed, as well as the first experimental results and the plans for a pilot plant having a capacity of 1 kg/day. The possible use of tri-lauryl-amine in the plutonium purification cycle is now under consideration for the processing plant at La Hague. The flowsheet for this process and its performance are presented. The possibility of vitrification is considered for the final treatment of the concentrated radioactive wastes from the Marcoule (irradiated uranium) and La Hague (irradiated uranium-molybdenum) Centers. Three possible processes are described and discussed, as well as the results obtained from the operation of the corresponding experimental units using tracers. Author

N65-33042# Weizmann Inst. of Science, Rehovoth (Israel).
RESEARCH ON MEASUREMENT OF PRESSURE INDUCED SHIFTS OF ABSORPTION LINES IN THE INFRARED SPECTRUM Annual Summary Report No. 4, Jan. 1–Jun. 30, 1964
J. H. Jaffe Oct. 1964 4 p refs
(Contract AF 61(052)-388)
(AFCRL-65-108; AD-617247) CFSTI: HC $1.00/MF $0.50

Continuing research and preliminary results are mentioned briefly in connection with the interpretation of pressure-induced shifts of high frequency lines observed in various noble gases, interpretation of line widths observed in oxygen-hydrogen flame, and a method for interpreting the spectra of HCl and DCl in solid argon. J.M.D.

N65-33067# European Atomic Energy Community. Brussels (Belgium).
THE DETERMINATION OF OXYGEN IN ORGANIC COMPOUNDS AND METALS BY ACTIVATION WITH 14 MeV NEUTRONS [DOSAGE DE L'OXYGENE DANS LES PRODUITS ORGANIQUES ET LES METAUX PAR ACTIVATION AUX NEUTRONS DE 14 MeV]
F. Girardi, J. Pauly, and E. Sabbioni May 1965 37 p refs In FRENCH; ENGLISH summary
(EUR-2290.f) CFSTI: HC $2.00/MF $0.50

The determination of oxygen was carried out with the reaction O^{18} (n,p)N^{18} by means of 14 MeV neutrons obtained from a neutron generator. This method was applied to routine analysis of organic materials (hydrocarbons of the terphenyl type) and to the determination of oxygen in metals. The effect of the various experimental parameters on sensitivity and precision was considered. Thus the influence of neutron flux inhomogeneity, of sample dimensions and variations of positioning during irradiation was studied. The comparison of two different types of detectors for measuring N^{16} and the methods used to calculate the oxygen concentration were described. By these studies the experimental conditions which are necessary to obtain a good precision and accuracy were established. In our routine operating conditions a detection limit of 40 p.p.m. for 10 g samples has been obtained. Modifications of the procedure which can lead to lower detection limits were discussed. Author

N65-33072# Atomics International, Canoga Park, Calif.
PYROCHEMICAL REPROCESSING OF UO_2 BY AIROX Summary Report
G. E. Brand and E. W. Murbach 31 Aug. 1965 66 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11389) CFSTI: $3.00

This process is based on the oxidation of UO_2 to U_3O_8 and reconversion to UO_2 by reduction with hydrogen. Three-foot sections of stainless steel clad UO_2 were effectively declad by piercing the cladding at 1-in. intervals and exposing to oxygen at ~400° C. Uranium oxide carried through three oxidation-reduction cycles was pressed and sintered at 1700° C. Pellets of over 98% theoretical density were produced. Killogram scale experiments, using oxides of stable isotopes of representative fission products simulating burnups up to 100,000 Mwd/MTU, showed no significant physical or chemical effect of these elements on the process. Material irradiated to 21,000 Mwd/MTU was declad, oxidized, and reduced through three cycles, pressed into pellets, sintered at 1700° C, re-irradiated to an additional 10,000 Mwd/MTU, and the process repeated. Final pellet densities were from 94 to 96% theoretical. Cesium, rare gases, and iodine were virtually completely removed. Tellurium was partially removed and ruthenium could be removed by carrying out one oxidation step above 725° C. No removal of rare earths was detected. Fuel cycle cost studies on UO_2 fuel, carried out for a 1000 Mw(e) complex (three BWR's), indicate an economic advantage for AIROX, as compared to aqueous reprocessing. Author

N65-33097# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

THERMAL DECOMPOSITION OF BIPHENYL [DECOMPOSITION THERMIQUE DU BIPHENYLE]

Michel Clerc (Ph.D. Thesis—Paris Univ.) 22 Jun. 1962 67 p refs In FRENCH; ENGLISH summary

(CEA-R-2386) CFSTI: HC $3.00/MF $0.75

The rates of formation of the decomposition products of biphenyl: hydrogen, methane, ethane, ethylene, as well as triphenyls have been measured in the vapor and liquid phases of 460° C. The study of the decomposition products of biphenyl at different temperatures between 400 and 460° C has provided values of the activation energies of the reactions yielding the main products of pyrolysis in the vapor phase. The rate of disappearance of biphenyl is only very approximately first order. Results show the major role played at the start of the decomposition by organic impurities which are not detectable by conventional physico-chemical analysis methods and the presence of which accelerates noticeably the decomposition rate. It was possible to eliminate these impurities by zone-melting carried out until the initial gradient of the formation curves for the products became constant. The composition of the high-molecular weight products (over 250) was deduced from the mean molecular weight and the dosage of the aromatic C-H bonds by infra-red spectrophotometry. As a result the existence in tars of hydrogenated tetra, penta and hexaphenyl has been demonstrated. Author

N65-33098# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

PLUTONIUM DOSAGE USING ISOTOPIC DILUTION. APPLICATION TO THE STUDY OF IRRADIATED FUELS [DOSAGE DE PLUTONIUM PAR DILUTION ISOTOPIQUE. APPLICATION A L'ETUDE DES COMBUSTIBLES IRRADIES]

Jean Chenouard and Monique Lucas Aug. 1964 44 p refs In FRENCH; ENGLISH summary

(Contract EURATOM-037-13-60-12 RDF)

(CEA-R-2563) CFSTI: HC $2.00/MF $0.50

The uranium/plutonium ratio can be determined in a fuel after irradiation by isotopic dilution using a solution containing uranium 233 and plutonium enriched in the 240 or 242 isotopes. A description is given of the measurement method, the calibration, the solution preparation techniques and the mass-spectrometric analysis. To use this method it is necessary, after mixing, for the isotopes to be distributed in the same way in the system both for the sample atoms and those of the tracer. This condition leads to difficulties which become apparent, particularly during calibration. The use of an electric computer has made it possible to reduce the time required for analysis and to simplify the checking of results. The U/Pu ratio can be determined to 3 or 4 percent of a ^{240}Pu-rich tracer is used, and to better than 2 percent using ^{242}Pu. ^{235}U consumption is measured by a particular technique involving a uranium hexafluoride analysis. The depletion is measured to $\pm 5 \times 10^4$. Author

N65-33099# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

DOSAGE OF PLUTONIUM BY ISOTOPIC DILUTION IN IRRADIATED FUELS [DOSAGE DU PLUTONIUM PAR DILUTION ISOTOPIQUE DANS LES COMBUSTIBLES IRRADIES]

Monique Lucas Aug. 1964 42 p refs In FRENCH; ENGLISH summary

(Contract EURATOM-037-13-60-12 RDF)

(CEA-R-2564) CFSTI: HC $2.00/MF $0.50

Plutonium determination in irradiated fuels has been carried out for several years by isotopic dilution by SECACI and SSM in collaboration. SECACI has made available to the SSM the necessary space and equipment in its Fontenay laboratories. This work has shown the importance of the valency cycle which should make it possible to obtain a uniform isotopic distribution in sample-tracer mixtures, and also a satisfactory U/Pu separation. Now it has been noticed that the presence of an excess of uranium considerably modifies the oxidation-reduction reaction kinetics of the plutonium. We have therefore been led to change certain parts of the operational technique so as to have an efficient cycle and to thereby improve the U/Pu separation; the stability of the thermionic emission of the plutonium, connected to the quantity of residual uranium, has at the same time been improved and we can now carry out more precise isotopic analyses. Author

N65-33136*# Borden Chemical Co., Philadelphia, Pa. Central Research Lab.

IMPROVED SEPARATIONS FOR SILVER OXIDE-ZINC AND SILVER OXIDE-CADMIUM CELLS FOR SPACECRAFT APPLICATION Final Report, Jun. 28, 1963–Sep. 27, 1964

Helmuth L. Pfluger and Howard E. Hoyt [1964] 72 p refs

(Contract NAS5-3467)

(NASA-CR-64607) CFSTI: HC $3.00/MF $0.75 CSCL 07D

Screening of many polymers established a principle of balanced polarity for the separator of alkaline silver-zinc battery cells. It was concluded that polarity must be sufficient for insolubility in concentrated alkali. This principle was applied to the preparation of homogeneous mixtures consisting of polar and less-polar polymers in systematically varied proportions, and composition ranges were obtained which resulted in insoluble and conducting films. Cellophane, hydroxyethyl cellulose, polyvinyl alcohol, and hydroxyethyl ether of polyvinyl alcohol were found to have a polarity balance within the desired range. A test was developed to assess oxidation resistance under conditions simulating cell chemistry. Degradation was measured as loss of tensile strength after exposure to alkaline solutions saturated with silver oxide. Two types of proprietary polyvinyl alcohol and four types of methyl cellulose-acid polymer combinations were used as membranes in constructing silver-zinc cells. M.W.R.

N65-33153# Brookhaven National Lab., Upton, N. Y.
CHEMICAL STATE OF IODINE RELEASED FROM IRRADIATED FUELS INTO STEAM
A. W. Castleman, Jr., I. N. Tang, and H. R. Munkelwitz Apr. 1965 10 p refs Submitted for Publication
(Contract AT(30-2)-GEN-16)
(BNL-9174)

The chemical states of iodine released from uranium irradiated over the range 3.0×10^{14} to 5.4×10^{19} nvt and from UO_2 and U_3O_8 powder samples irradiated up to 3.0×10^{10} nvt were studied within the temperature range 1000° to 1300° C. Under the conditions of a reactor accident, most of the iodine is initially dissociated to atomic iodine. Although atomic iodine is quite reactive because of its unpaired electron, highly exothermic gas phase reactions with other fission product atoms are precluded since the energy of reaction goes to a vibrational mode and the molecule dissociates. Such actions generally require third body collisions for stabilization. Reactions with hydrogen should proceed since one hydrogen atom removes the energy of reaction in the form of transitional energy. The results of this experimental study show that in the presence of a metal-water reaction, the iodine released from both uranium and dioxide will be largely converted to HI. In air HI will be oxidized; in the absence of hydrogen, most of the iodine released from UO_2 will be elemental. E.E.B.

N65-33154# Argonne National Lab., Ill.
ISOTOPIC SPECTRAL ANALYSIS OF BORON [IZOTOPNYI SPEKTRALNYI ANALIZ BORA]
A. G. Zhiglinskii and A. S. Kochemirovskii Nov. 1964 7 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Fiz. i Khim. (Leningrad), no. 16, 1963 p 62–68
(ANL-TRANS-133)

Some methods of determination of boron isotopic composition by the atomic spectrum (the analytic Line $B\pi\ \lambda = 345$ 1A) and by the molecular spectrum BO (band 1-0 of β-system, $\lambda = 2255$A) have been suggested. The photographic method of registration was used, the analysis being performed by means of graduated diagrams. The relative error in the determination of the isotope, which is present in a minor quantity, is about 2–5% in the atomic spectrum analysis and 2–3% in the molecular spectrum analysis. Author

N65-33165# Brookhaven National Lab., Upton, N. Y.
LIQUID FUEL SYNTHESIS USING NUCLEAR POWER IN A MOBILE ENERGY DEPOT SYSTEM
M. Steinberg and M. Beller Oct. 1964 9 p refs
(Contract AT(30-2)-GEN-16)
(BNL-8489)

The synthesis of methanol fuel in mobile field units of modern armies is discussed. It is proposed that CO_2 is extracted from the air through absorption and subsequently reacted with H_2—produced by water electrolysis—to form methanol. A set of requirements for the necessary conversion of nuclear heat to dc electric power to produce about 1000 gallons methanol per day is presented. An open cycle power system incorporating CO_2 absorbers is illustrated that compresses CO_2 and H_2 at 200 atm and uses metal oxide mixtures as catalysts in the reaction chamber. This reaction process is self-sustaining and converts 15 to 20 percent of the CO_2 during each catalyst pass. G.G.

N65-33213# Bologna Univ., (Italy). Instituto di Scienza Dei Metalli e Metallurgia.
RESEARCH INTO THE CHEMICAL BEHAVIOR OF SURFACES OF SINGLE- AND BI-CRYSTALS UNDER DIFFERENT EXPERIMENTAL CONDITIONS Quarterly Technical Status Report, 1 Aug.–30 Oct. 1964
Paolo Spinedi [1964] 20 p refs
(Contract DA-91-591-EUC-3202-452-0040)
(QTSR-3; AD-461078) CFSTI: HC $1.00/MF $0.50

The chemical behavior of single crystals of germanium with known orientation under controlled oxidation was investigated to determine the optimal conditions that would favor the formation of oxidation patterns which represent the micro and macro defective state of the surface. The activation of the oxidating fluid due to the presence of water vapor or ozone, or of the surface exposed to the treatment due to a localized plastic deformation results in oxidation even at temperatures low in comparison to the melting point of the substratum. As the temperature changes, the crystal faces of the oxide are changed. The orientation of the surface subjected to treatment has only a limited effect on the oxidation process. R.N.A.

N65-33218# Auburn Univ., Ala. Dept. of Chemistry.
A STUDY OF THE DECOMPOSITION MECHANISM OF AMMONIUM PERCHLORATE Quarterly Report, 1 Oct. 1964–1 Jan. 1965
James E. Land [1965] 27 p
(Contract DA-01-009-ORD-1023(Z))
(QR-3; AD-462948)

Differential thermal analysis (DTA) data are tabulated concerning experimental determination of heating rates for ammonium perchlorate (AP) samples. Fine, medium, and coarse AP particles were tested. The DTA runs were made under elevated pressure of nitrogen gas to minimize the sublimation tendency of AP. The summary of these tests shows the number of peaks observed, slopes of the DTA curves, and the calculated activation energies. Similar data show the effect of glass beads used to dilute the experimental material. Data are also included on the catalytic effect of iron and aluminum oxides on the activation energy of AP decomposition. J.M.D.

N65-33241# Tem-Pres Research, Inc., State College, Pa.
DEVELOPMENT OF HYDROTHERMAL METHOD FOR GROWING HIGH PURITY SINGLE CRYSTALS OF BERYLLIUM OXIDE AND LEAD METANIOBATE Progress Report, Oct. 1–Dec. 31, 1964
V. G. Hill and R. I. Harker Wright-Patterson AFB, Ohio, AF Mater. Lab., 15 Jan. 1965 29 p refs
(Contract AF 33(615)-1712)
(PR-2; AD-463710)

The solubility values of BeO in 4, 6, and 8 normal NaOH, KOH and LiOH solutions were determined under hydrothermal conditions at temperatures between 400 and 800° C, and pressures up to 60,000 p.s.i. The results show that the solubility of BeO in these solutions increases with alkali concentration and linearly so with temperature over the ranges studied. However, the currently available data do not unequivocally determine the effects of pressure over the range studied, but they do suggest that it has little if any effect on the solubility in sodium hydroxide solutions. Crystals grown below 600 ±25° C in NaOH solutions were predominantly bipyramids, while those grown above this temperature were mainly prismatic. KOH solutions seem to have the opposite effects, and LiOH appears to favor prismatic growth. Sodium hydroxide solutions of BeO were self-nucleating above 560° C. The alkali solutions appear to offer better possibilities of the hydrothermal method than do the acid ones because of growth rate problems in the latter media. Author

N65-33291# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.

ENERGY BALANCE OF THE CATHODE CONNECTION AND CALCULATION OF THE YIELD OF CAESIUM DIODES [BILAN DES ENERGIES DANS LA CONNEXION DE CATHODE ET CALCUL DU RENDEMENT DANS LES DIODES A CESIUM]

René Merard 1964 13 p In FRENCH, ENGLISH summary (CEA-R-2598) CFSTI: HC $1.00/MF $0.50

The cathode connection is one of the critical elements in the calculation of the yield of caesium diodes. In particular a study is made of the balance of the losses due to the Joule effect, to radiation and to thermal conduction as a function of the shape and the nature of the cathode connection. The internal voltage drop of the diode is obtained from the expression for the total Joule losses of the metallic conductors. The length of the cathode connection is calculated as a function of the losses and yield is optimized as a function of the relationship existing between the cathodic losses due to thermal conduction and the Joule losses in the connection. The calculations lead to hyper-elliptic integrals which can only be manipulated by series development. The results obtained are approximate. Author

N65-33302# Ozark-Mahoning Co., Tulsa, Okla.

SYNTHESIS OF NEW FLUORINE CONTAINING COMPOUNDS Quarterly Technical Summary, 1 Apr.–30 Jun. 1965

C. Pupp and J. B. Beal [1965] 18 p refs
(Contract AF 04(611)-9556; ARPA Order 24)
(AD-468514)

Effort has been directed toward the synthesis, under condition of high pressure, compounds containing energetic moities, such as OF^+ or $NO_2F^{=}$. The pressures used have ranged from about 15,000 psi down to several atmospheres. Temperatures have been varied from room temperature to about 350°. Experiments made were those in which OF_2 was allowed to react with a hyponitrite, nitrite, or nitrate. Other work has continued the investigation of the reactions of OF_2 with the arsenic and antimony pentafluorides as well as other Lewis acids to determine the mechanism that accounts for the formation of the salts, O_2AsF_6 and O_2SbF_6. A mechanism for these reactions is postulated. The attempts to prepare dioxygenyl salts with other Lewis acids were unsuccessful. Another approach to the synthesis of OF^+ has been undertaken. This work involves the reaction of OF_2 with SbF_5 and AsF_5 using IF_5 as the reaction medium. The previously unreported complex, $IF_5 \cdot AsF_5$, has been found and appears to be the only product. Author

N65-33306# Cornell Univ., Ithaca, N. Y.

NON-EQUILIBRIUM EFFECTS IN THE KINETICS OF GAS PHASE REACTIONS

Neil S. Snider and John Ross (Brown Univ.) 1965 31 p refs Prepared jointly with Brown Univ. Submitted for Publication
(Contract Nonr-3623(00); Proj. Squid)
(BRN-14-P; AD-468565)

A theoretical rate equation derived for exchange reactions in the gas phase from an assumed Boltzmann equation yields statistical rate expressions for theoretical rate coefficients which in general are functions of concentration with a ratio not equal to the equilibrium constant, K. However, the theoretical rate equation may be rearranged to yield rate coefficients defined to obey the relation $K_{F,C}/K_{r,c} = K$. The rate coefficients $K_{F,C}$ and $K_{r,c}$ are also functions of concentration except in three linear cases: 1. a reaction with one of the components present in large excess; 2. a chemical reaction proceeding unaffected by inelastic processes; 3. an isomerization reaction proceeding in a large excess of inert gas. Thus for these three cases the usual phenomenological rate equation (Eq. (2)) applies. In Cases 1 and 3 the rate constants are determined not only by chemical reaction cross sections but also by inelastic cross sections for at least some and possibly all reactants and products. Author

N65-33309# Aerospace Corp., El Segundo, Calif. Lab. Operations.

PHOTOLYSIS OF LOW TEMPERATURE GLASSES. II: TEMPERATURE AND OXYGEN EFFECTS IN ETHANOL AND ETHER

H. S. Judeikis and Seymour Siegel Jun. 1965 26 p refs
(Contract AF 04(695)-469)
(TDR-469(5250-20)-1, Vol. II; SSD-TR-65-71, Vol. II)

The effect of temperature and oxygen on the processes occurring in the aromatic solute-sensitized photodecomposition of ethanol and ether glasses is described. The results are discussed in terms of the proposed sensitization mechanism, and they are shown to be in excellent agreement with predictions. The effect of oxygen diffusion (at ~ 100° K) is to remove the aromatic solute triplet-state population, the latter being an intermediate in the sensitization mechanism, and thus decrease the rate of radical formation. Oxygen also reacts with any radicals present to form peroxy radicals which are stable to light with wavelengths greater than ~2500° Å. In the absence of oxygen, the triplet-state population and rate of total radical production are virtually independent of temperature over the range 77° to 125° K. However, the composition of the radical concentration exhibits a strong temperature dependence. It is shown that the latter observation results from a competition between secondary photoreactions (temperature independent) involving the radicals produced by the sensitization process and abstraction reactions (temperature dependent) involving the products of the secondary photoreactions. Author

N65-33310# Fulmer Research Inst., Ltd., Stoke Poges (England).

HEATS OF FORMATION OF COMPOUNDS CONTAINING B, Be, Al AND Li Administrative Report No. 17, 30 Jun.–30 Sep. 1964

P. Gross Sep. 1964 8 p
(Contract AF 61(052)-447; ARPA Order 317-12)
(AD-459506) CFSTI: HC $1.00/MF $0.50

Continued research conducted under a program designed to determine the heats of formation of compounds containing boron, beryllium, aluminum, and lithium, is reported. Presented are data from experimental studies of beryllium fluoride, double oxides, and mixed fluorides. To improve the efficiency of stirring with the new calorimeter, two platinum deflectors were introduced. Cited are solution experiments on mixtures of boron oxide and gibbsite; solution experiments on a mixture of B_2–O_3 and Al_2–$O_3 \cdot 3H_2O$ in the ratio of the compound $9Al_2O_3 \cdot 2B_2O_3$, and experiments on the compound itself; and further experiments on Li_3–AlF_6. S.C.W.

N65-33315# Aerojet-General Corp., Sacramento, Calif.

DESIGN HANDBOOK FOR LIQUID FLUORINE GROUND HANDLING EQUIPMENT

Edwards AFB, Calif., AF Rocket Propulsion Lab., Aug. 1965 482 p refs 2nd edition
(Contracts AF 33(616)-6586; AF 04(611)-10541)
(AFRPL-TR-65-133; AD-468216)

Available storage, handling, and materials data on liquid fluorine were collected into this comprehensive design handbook. The handbook presents detailed engineering data for the

design, operation, and maintenance of a liquid fluorine facility. In addition, it provides instructions for the storage, transfer, and handling of liquid and gaseous fluorine, and includes available safety and materials information. R.N.A.

N65-33320# Temple Univ., Philadelphia, Pa. Research Inst.
[THE PRODUCTION, ISOLATION, AND IDENTIFICATION OF, O_2F AND O_3F RADICALS] First Quarterly Progress Report, 1 Oct.–31 Dec. 1963
A. D. Kirshenbaum and A. V. Grosse [1963] 14 p ref
(Contract AF 04(611)-9555)
(QPR-1; AD-428142)

Recent results in a program to produce, isolate, and identify OF radicals for use in synthesizing new oxidizers are reported. Production of radicals by bombarding O_2F_2 and O_3F_2 with hydrogen atoms at 77° K or lower is described theoretically. The Wood's electric discharge apparatus for the hydrogen atom production and bombardment is shown. Reaction of CF_4 with hydrogen atoms at 77° K for 75 minutes yielded a product that contained both HF and C_2F_6. A similar experiment with O_2F_2 yielded HF, H_2O_2, and water. Another test showed that ozone can be separated from O_2BF_4 by hydrogen atom bombardment. Irradiation with cobalt-60 gamma rays at 77° K is also being studied for production of OF radicals. A test with O_2F_2 showed the presence of strong paramagnetic resonance containing at least 10^{19} spins, and the spectrum indicates the presence of at least two free radical species. J.M.D.

N65-33325 Newcastle Univ. (England).
RESEARCH ON ORGANIC RADIATION CHEMISTRY Technical Report, Oct. 1961–Oct. 1964
G. A. Swan and L. T. Allan Wright-Patterson AFB, Ohio, AF Mater. Lab., Jun. 1965 46 p refs
(Grant AF-EOAR-61-35)
(AFML-TR-65-166; AD-468196)

The report is divided into four parts. Part I is a gas chromatographic study of the radiolyses products of diethylamine, triethylamine, N-butylamine and 1-methylpiperidine. Part II is a discussion of the extent of the γ-radiation induced addition of tertiary amines to alkenes. Part III deals with the photolysis of diethylamine and triethylamine. Part IV discusses the irradiation of o-bromoaniline. Author

N65-33326# Esso Research and Engineering Co., Baytown, Tex.
REACTIONS OF GASEOUS BRØNSTED ACIDS
M. S. B. Munson Jul. 1965 20 p refs Submitted for Publication
(Contract Nonr-3623(00); Proj. Squid)
(HUM-13-P; AD-468562)

Gaseous ionic reactions have been observed for a series of oxygenated compounds in the source of a mass spectrometer at pressures up to a few tenths of a torr. The major product ions were the solvated protons. Major differences in relative abundances were observed for the higher solvated protons which suggested differences in stability: no more than two molecules of dimethyl ether, acetaldehyde, or acetone will be strongly bound to a proton, but more highly solvated protons will be stable for methanol (3), formic acid (3), and water (4). There are general areas of agreement between ionic reactions in the gas phase and their macroscopic counterpart. Reactions of protonated molecule-ions were observed in methanol, acetaldehyde, and acetone which may be considered as elementary steps of some of the acid-catalyzed reactions which occur in solution. Proton transfer was observed from H_3O^+ to HCOOH and the decomposition path of lowest energy for $HCOOH_2^+$ is the one which gives H_3O^+ and CO. Author

N65-33336# ARO, Inc., Arnold Air Force Station, Tenn.
ADSORPTION OF HYDROGEN BY A THIN FILM OF TITANIUM
S. M. Kindall Arnold Eng. Develop. Center, Aug. 1965 47 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-65-113; AD-468316)

Past experience has shown that the capture coefficient of a titanium surface for hydrogen is strongly dependent upon the surface temperature and the conditions under which the film is formed. This report presents the results of an investigation which determined the importance of some of the variables. It was found that the capture coefficient increased as the titanium surface temperature was decreased from 273 to 77° K. Moreover, the capture coefficient could be further increased by lowering the temperature of the substrate upon which the titanium film was deposited from 273 to 77° K. Also, the capture coefficient was found to be independent of film thickness and chamber pressure but increased when the deposition was carried out in an inert helium atmosphere. For the range of conditions investigated, the sticking fraction was found to vary from 0.01 to 0.5. The experimental data suggest that surface diffusion is an important part of the mechanism by which titanium captures hydrogen. Calculations using a theoretical model which incorporates diffusion agreed well with the experimental results. Author

N65-33376# Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Electronics.
LATTICE CONSTANTS OF ORTHOFERRITES
M. Eibschütz 15 Sep. 1964 12 p refs
(Contract AF 61(052)-654)
(TN-11; AD-615587)

The lattice parameters of the orthoferrites $RFeO_3$, where R is one of the trivalent rare earth ions Y, Tb, Dy, Ho, Eu, Tm, Yb, and Lu, are calculated using Cohen's analytical method. The parameters, a and c, vary regularly with the atomic number (or the ionic radius) of R, however the b parameter remains almost constant. Author

N65-33404# Aberdeen Proving Ground, Md. Army Coating and Chemical Lab.
DIMENSIONAL ANALYSIS OF TWENTY EIGHT DETERGENCY SYSTEMS Final Report
A. Mankowich 14 Jul. 1965 27 p refs
(CCL-181; AD-468289)

Replacement of micellar solubilization by surfactant concentration as one of the six significant variables of the detergency process resulted in a more useful set of dimensionless products. The change affords easier and more accurate experimental control over the products, and an improved detergency diagram. The latter, representing a log-log function of two of the dimensionless products at parameter values of the third, consists of a series of parallel lines with a negative slope of approximately 45°. The dimensional analysis was validated by twenty-five soil-surfactant systems formed from six different types of soil and seven surfactants including two types of anionics and two types of nonionics. Non-validation of the products of a dimensional analysis in which the dimensions of detergency were changed to those of energy, or ML^2/T^2 (M = mass, L = length, T = time), tended to confirm the simplified model of the process and dimensions (ML) previously postulated. Author

N65-33406# Istituto Superiore di Sanita, Rome (Italy).
USE OF THE HOLLOW CATHODE LIGHT SOURCE FOR DETECTION AND DETERMINATION OF TRACE ELEMENTS Third Report, Jul. 1–30 Sep. 1964

Giulio Milazzo [1964] 3 p
(Contract DA-91-591-EUC-3187)
(AD-461047) CFSTI: HC $1.00/MF $0.50

Use of a photographic emulsion to detect the presence of iodine is described. The emulsion is particularly sensitive to vacuum ultraviolet, and was used in determining the dilution limit in which iodine charged as potassium iodide can be detected in an aluminum hollow cathode. The limit of detectability was also evaluated where the potassium iodide is an impurity in a matrix of potassium chloride in the cathode. In both cases it was found that iodine spectral lines can be observed even for exceedingly minute amounts of iodine. J.M.D.

N65-33408# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HIGH PRESSURE HYDROGENATION OF HEAVY PETROLEUM DISTILLATES
V. Mraz, O. Krafft, and R. Kubicka 12 May 1965 17 p refs Transl. into ENGLISH from Acta Chim. Acad. Sci. Hung. (Hungary), v. 36, no. 1, 1963 p 269–277
(FTD-TT-64-1348/1+2; AD-467247)

Processes of treatment of heavy petroleum distillates in a hydrogenation plant are disclosed, viz. the high pressure hydrorefining and the high pressure hydrocracking at 300 at. The hydrogenation products formed in the high pressure hydrorefining are very good raw materials for producing high quality lubricating oil, as well as light paraffin and ceresine products. By means of high pressure hydrocracking, either motor fuel can be obtained as main product, or the heavy distillate can be converted into diesel oil by means of the selective catalysts developed recently. A high grade jet fuel can also be obtained in this process. The two process methods mentioned involve a considerably more favorable utilization of the imported sulphur-containing paraffinic crude. Author

N65-33412# Florida Univ., Gainesville. Dept. of Chemistry.
RESEARCH ON SYNTHESIS OF UNSATURATED FLUOROCARBON COMPOUNDS Semiannual Report, 1 Oct. 1963–31 Mar. 1964
Paul Tarrant, Jim Heyes, David Sayers, Ward Oliver, and A. C. Wright [1964] 26 p refs
(Contract DA-19-129-AMC-79(N))
(SAR-2; AD-461029)

Progress is reported on research on the preparation of unsaturated organic compounds containing fluorine and on the preparation of various fluoro-olefins which may give elastomers which are oil and fuel resistant and which retain their elasticity at low temperatures. Allyl magnesium bromide was found to react with a number of fluoro-olefins to give reasonable yields of the 1, 4-dienes. The reaction of fluoro-olefins with vinyl organometallics and the mono- and di-metallic acetylenes was not successful. Also the codimerization of $CF_2 = CFBr$ and $CF_2 = CFCH_2CH_2Br$ was successful and reactions of the product were investigated. The preparation of 1, 2 bis(pentafluorophenyl)hexafluorocyclo-1-butene is described. Further, silanes with trifluorovinyl grouping were prepared and the reaction of highly fluorinated keytones with organometallics to give tertiary carbinols was investigated.
E.E.B.

N65-33413# Florida Univ., Gainesville. Dept. of Chemistry.
RESEARCH ON SYNTHESIS OF UNSATURATED FLUOROCARBON COMPOUNDS Semiannual Report, 1 Apr.–30 Sep. 1964
Paul Tarrant, David Sayers, Jim Heyes, Ward Oliver, A. C. Wright et al [1964] 25 p refs
(Contract DA-19-129-AMC-79(N))
(SAR-3; AD-461030)

The relative reactivity of various fluoroölefins in their reaction with allylmagnesium bromide was investigated. Reactions of some other allylic Grignard reagents with fluoroölefins are described. A convenient route to 1,2- difluoroölefins is provided by the alcoholysis of substituted trimethyldifluorovinylsilanes prepared by the action of organolithium reagents on trimethyltrifluorovinyl silane. The preparation of pentafluoroallyl bromide and some new fluorodiolefins is described. Author

N65-33415# National Bureau of Standards, Washington, D. C. Electrolysis and Metal Deposition Section.
DEPOSITION OF TUNGSTEN BY REDUCTION OF THE HEXAFLUORIDE WITH HYDROGEN IN THE VAPOR PHASE Quarterly Report, 1 May–1 Aug. 1964
Jean H. Connor and Abner Brenner 14 Aug. 1964 5 p
(Contract AF 33(615)-1004)
(QR-3; AD-461031)

Oxygen and hydrogen fluoride were shown to slow the rate of deposition of tungsten or inhibit it entirely. One-third to about one-half of the tungsten hexafluoride initially present in the reaction chamber was reduced to metal. It was shown that as the deposition slowed down the volume of HF presumably in the reaction vessel was several times the volume of WF_6 remaining in the vessel. The results indicated that the reaction was not sensitive to the presence of hydrogen fluoride. In the deposition of tungsten from the vapor phase, the gaseous pressure of the system should have increased because for each 4 volumes of reactants that disappeared, 6 volumes of hydrogen fluoride should have appeared, but did not. Instead, a slight diminution of pressure frequently occurred. The HF was suspected of reacting with the ceramic vessel containing the reaction mixture, but the same results were obtained with a stainless steel vessel. It was then hypothesized that some of the hydrogen fluoride reacted with the tungsten hexafluoride to form a compound.
R.W.H.

N65-33416# Thiokol Chemical Corp., Denville, N. J.
NITROSO RUBBER RESEARCH, DEVELOPMENT AND PRODUCTION
Joseph Green [1964] 26 p refs Prepared in part at Thiokol Chem. Corp., Trenton, N. J.
(Contract DA-19-129-AMC-69(X))
(RD-343-Q6; RMD-8576-Q6; AD-461044)

Additional CF_3NO and CF_3NO/C_2F_4 copolymer production lots were successfully completed although detonations were experienced in two CF_3NO runs. An additional 138 pounds of CF_3NO and 87 pounds of copolymer were prepared. Modifications of laboratory bulk copolymerizations resulted in products with inherent viscosities up to 2.88 indicating molecular weights to $> 3,000,000$. Vulcanizates obtained from production copolymer were of low strength. Terpolymerization and termonomer studies were continued. Author

N65-33426# Los Alamos Scientific Lab., N. Mex.
PREPARATION OF ULTRA-HIGH PURITY PLUTONIUM
J. A. Leary and L. J. Mullins 30 Aug. 1965 9 p refs
(Contract W-7405-ENG-36)
(LA-3356-MS) CFSTI: $1.00

Described is a method for eliminating the detectable metallic impurities from electrorefined plutonium. The technique involved the use of a carburized tantalum cathode in place of the standard tungsten cathode. The Ta cathode was carburized by heating in a hydrogen atmosphere to ~1700°C in the presence of carbon. The coating was approximately 17-μ thick. The exterior phase was TaC (~12μ); the phase adjacent to the Ta substrate was probably Ta_2C. A total of five runs were conducted after which each Pu product

ring was sampled. It was demonstrated that carburized Ta cathodes introduce less refractory metal into the Pu metal than do W cathodes. Reuse of the carburized cathode for more than two runs is not recommended if high-purity Pu is desired. Overall results indicate tht Pu with less than 50 ppm metal impurities can be prepared routinely using the proposed technique. It was also demonstrated that all metal impurities can be reduced to limits of detectability except for Americium which grows in after refining. The gas element impurities H and O can be reduced significantly by handling the metal in inev atmosphere gloveboxes. S.C.W.

N65-33436# Los Alamos Scientific Lab., N. Mex.
THE CONTROLLED POTENTIAL ELECTRODEPOSITION OF COBALT FROM PLUTONIUM-CERIUM-COBALT ALLOY SOLUTIONS
Joel W. Dahlby and Glenn R. Waterbury 30 Aug. 1965 13 p refs
(Contract W-7405-ENG-36)
(LA-3345) CFSTI: $1.00

A method was developed for the determination of 25 to 200 mg. of cobalt in plutonium-cerium-cobalt alloys. The cobalt is electrodeposited from basic ammonium sulfate solution containing sulfite ion at a controlled potential of −1.00 to −1.05 volts vs. a saturated calomel electrode and at a temperature in the range of 70 to 90° C. The plutonium and cerium are complexed and held in solution by citrate ion. Recoveries of 27-, 54-, 109-, and 221-mg. quantities of cobalt were 99.3, 99.7, 99.9, and 100.0% with relative standard deviations of 0.57, 0.30, 0.13, and 0.12%, respectively. Of 35 added ions, 17 did not cause a deviation in the cobalt recovery greater than 0.5%. Author

N65-33440# RAND Corp., Santa Monica, Calif.
QUASILINEARIZATION AND THE ESTIMATION OF CHEMICAL RATE CONSTANTS FROM RAW KINETIC DATA
R. Bellman, J. Jacquez, R. Kalaba, and S. Schwimmer Aug. 1965 14 p refs
(Grant PHS-GM-09608-04)
(RM-4721-NIH)

A technique for estimating chemical rate from raw kinetic data is suggested. Such problems are viewed as nonlinear multi-point boundary value problems for systems of nonlinear ordinary differential equations, for which the quasilinearization procedure offers an effective means of numerical solution. The method is illustrated using kinetic data, obtained by Bodenstein and Lindner, on some gas phase reactions of nitrogen and oxygen. Author

N65-33455# Consolidation Coal Co., Library, Pa. Research Div.
EVALUATION OF BETA RADIATION AS A HYDROGENATION CATALYST Interim Technical Status Report, Mar. 1, 1962–Oct. 31, 1963
P. M. Yavorsky and E. Gorin 11 Sep. 1964 76 p refs
(Contract AT(30-1)-2978)
(NYO-2978-34) CFSTI: $3.00

The concept of using high intensity beta radiation from an isotopic source, Sr-90, inside a high temperature, high pressure chemical reactor has been developed for potential radiation chemical processes. Distinct advantages include high utilizable intensity from a relatively small source with a minimum of shielding against external radiation. Radiation processing studies at elevated temperatures and pressure showed that radiation does not significantly promote hydrogenation in the form of hydrogen addition to the aromatic structure of coal extract nor aromatic model compounds. Radiation does cause a marginal increase in the rate of hydrocracking of coal extract at 429° C, but not sufficient for exploitation. The ultimate extent of hydrocracking was the same as for the purely thermal reaction. Radiation was found to promote hydrofining, the removal of nitrogen and sulfur from distillate oils derived from hydrogenated coal extract. Author

N65-33458# Engelhard Industries, Inc., East Newark, N. J.
INVESTIGATION OF THE PARA-ORTHO CONVERSION OF HYDROGEN Final Report, Jul. 1963–May 1965
A. J. Haley and S. G. Hindin Jul. 1965 35 p refs
(Contract AF 33(657)-11125)
(AFAPL-TR-65-59; AD-468293)

This report presents the results of a program for the development of a precious metals catalyst for the low temperature para-ortho conversion of hydrogen. This program has resulted in the development of a catalyst with an activity such that 4.5 lbs are required for the conversion of 1 lb normal H_2/second to 70% of the equilibrium composition at liquid nitrogen temperature. In the course of this development measurements of X-ray diffraction, chemisorption, surface area, pore size distribution and magnetic susceptibility were used in an attempt to correlate catalyst activity. Catalyst activation studies and catalyst sample chamber geometry studies showed that process conditions affected catalyst activity. Author

N65-33466# Eagle-Picher Co., Miami, Okla. Research Labs.
RESEARCH IN PURIFICATION AND SINGLE CRYSTAL GROWTH OF II–VI COMPOUNDS
Lloyd W. Brown, John T. Buford, R. H. Fahrig, A. L. Fluesmeier, John R. Musgrave et al Wright-Patterson AFB, Ohio. ARL May 1965 129 p refs
(Contract AF 33(657)-71271)
(ARL-65-100; AD-619279)

The preparation and purification of elemental cadmium by zone refining are described. A comparison of the emission and mass spectrographic results on the zoning of a doped cadmium test bar is presented. The syntheses of high purity cadmium sulfide, cadmium selenide, zinc sulfide, and zinc selenide by the direct reaction of their gaseous elemental constituents are discussed. Emission and mass spectrographic data on synthesized cadmium sulfide are compared. The syntheses of zinc telluride, mercuric sulfide, mercuric selenide, and mercuric telluride by the combination of the elements in the liquid phase are outlined. A method for preparing barium telluride by the reduction of barium tellurate is given. Special handling techniques and X-ray characterization of this material are presented. Crystal growth of cadmium sulfide, zinc sulfide, cadmium selenide, zinc selenide, and mixed crystals of zinc sulfide-zinc selenide from the melt in a high pressure furnace is discussed. Doping of melt grown crystals is described. A discussion of the crystal growth of cadmium sulfide, zinc sulfide, and cadmium oxide by vapor phase techniques is presented. Measurements of resistivity and infrared transmission of some cadmium sulfide and zinc sulfide crystals are given. Author

N65-33476# Arctic Health Research Center, Anchorage, Alaska.
COLOR REMOVAL FROM SURFACE WATERS BY HYPOCHLORITE: FIELD TESTS ON WATER AT KOTZEBUE AIR FORCE SITE
Walter R. Wilson and John L. S. Hickey Ft. Wainwright, Alas., Arctic Aeromedical Lab., Jan. 1965 12 p refs
(AAL-TDR-64-18; AD-614995)

A practical method was sought for removing the unacceptably high color and chlorine demand from the surface water source used at Kotzebue Air Force Site. Earlier labora-

tory tests of this water had indicated that treatment with 10 to 40 ppm chlorine would produce satisfactory water, with 95% color removal. Field tests were conducted at the site in 1962 and 1963. Treatment with 32 ppm chlorine reduced color from 70 cobalt units to 10–15 units in 24 days, with a final chlorine residual of 2 ppm. Treatment with 21 ppm chlorine reduced color to 20 units in 82 days, at which time the chlorine residual was zero and recoloration began. Although results of the field tests did not entirely agree with laboratory findings, the 32 ppm chlorine dose was found to be a satisfactory, simple and practical method of treatment. Reduction of chlorine residual to an acceptable level occurred within 24 days following treatment. Author

N65-33490# Naval Radiological Defense Lab., San Francisco, Calif.
THE SORPTION OF TRITIUM AND TRITIATED WATER VAPOR BY A FOAMED POLYVINYLCHLORIDE (ENSOLITE)
S. Jacobs 20 Jan. 1964 31 p refs
(USNRDL-TR-717; AD-434218)

Of primary interest was the elucidation of both the rates and total extent of the sorption and desorption under isothermal conditions. It was found that Ensolite sorbed both tritium and tritiated water vapor rapidly, achieving in most cases over 90% of the equilibrium value within 24 hrs. The amount of tritium sorbed by Ensolite was found to be proportional to the initial gas-phase tritium concentration. The tritium desorbed readily, forming a gas-phase concentration that increased with the amount of tritium initially sorbed by the Ensolite. Repetitive (cyclic) desoprtion of tritium from Ensolite and desorption in a flow system yielded results that showed that the tritium would continually desorb until the amount remaining in the system was negligible. The sorption of tritiated water vapor by Ensolite was both much more rapid and extensive than the corresponding sorption of tritium. In a manner analogous to tritium, tritiated water vapor desorbed into a flow system until a very small amount of activity remained in the system. Author

N65-33494# Peninsular ChemResearch, Inc., Gainesville, Fla.
SYNTHESIS AND POLYMERIZATION OF FLUORINATED SULFUR MODIFIED NITROSO RUBBER Quarterly Report, 1 Apr.–30 Jun. 1965
Eugene C. Stump, Ward H. Oliver, and Calvin D. Padgett 23 Jul. 1965 31 p refs
(Contract DA-19-129-AMC-152(N)(O19116)
(QR-8; AD-469354)

Methyl nitrite reacts with perflurosuccinic and perfluoroglutaric anhydride to give $CH_3O_2C(CF_2)_3COONO$ and $CH_3O_2C(CF_2)_2COONO$, respectively. Pyrolysis of these nitrites under vacuum at 200–250° gives $CH_3O_2C(CF_2)_3NO$ and $CH_3O_2C(CF_2)_2NO$. Additional polymer samples containing $CF_2 = CFBr$ have been prepared. Attempts to incorporate 1,2-difluoroethylene, acrylonitrile, $CF_2 = CFCF_2CO_2CH_3$, $CF_2 = CFCF_2CO_2C_2H_5$ and $(CH_3)_2NNO$ as comonomers or termonomers were unsuccessful. A terpolymer containing $CH_3O_2C(CF_2)_3NO$ was prepared. Author

N65-33509# Bureau of Mines, Washington, D. C.
THE MASS SPECTRA AND CORRELATIONS WITH STRUCTURE FOR 14 ALKYLTHIOPHENES
Norman G. Foster, D. E. Hirsch, R. F. Kendall, and B. H. Eccleston 1965 35 p refs
(BM-RI-6671)

The mass spectra of 14 previously unreported alkylthiophenes are presented. Low ionization voltage data of selected compounds from these 14 and 23 previously reported alkylthiophenes are presented and discussed for their value in supporting fragmentation mechanisms and analytical correlations. A comparison with and corroboration of earlier correlations is made. Additional correlations concerning detection of side chain branching and the detection of ethyl-alkyl and propyl-alkylthiophenes are made. A discussion of the possible fragmentation routes and mechanism of fragmentation is given. Speculative structures are inferred about some of the ions and hence this work provides a basis for suggesting fragmentation mechanisms for the alkylthiophenes according to modern theories of mass spectrometry. Verification of these mechanisms must await the availability of isotopically labeled molecules which are labeled in specific locations that permit the definition of the paths of fragmentation. Some suggestions for further work to generalize on the correlations and studies made to this point are presented. Author

N65-33514# Peninsular ChemResearch, Inc., Gainesville, Fla.
SYNTHESIS AND POLYMERIZATION OF FLUORINATED SULFUR MODIFIED NITROSO RUBBER Quarterly Report, 1 Jul.–30 Sep. 1964
Eugene C. Stump, Ward A. Oliver, Calvin D. Padgett, and Larry Sapp 21 Oct. 1964 36 p refs
(Contract DA-19-129-AMC-152(N))
(QR-5; AD-461060)

A number of fluorine-containing diolefins were used as comonomers or termonomers. Perfluorobutadiene gave an elastic gum with CF_3NO. A terpolymer of $CF_3SCF(NO)CF_2Cl$ with $CF_3NO/CF_2 = CF_2$ was prepared. Low molecular weight nitroso polymer was prepared for NMR analysis. The use of chain transfer agents to obtain predetermined end groups is being examined. Efforts to prepare SF_5COOH and SF_5CF_2COOH continued. Silver pentafluorobenzoate was reacted with nitrosyl chloride to give pentafluorobenzoyl nitrite, which apparently decarboxylates slowly under vacuum to give pentafluoronitrosobenzene. p-Nitrosotetrafluorobenzoic acid was not isolated from the pyrolysis of tetrafluoroterephthaloyl mononitrite. Nearly 400 g. of CF_3NO was prepared. Author

N65-33533# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
INFLAMMABILITY OF MAGNESIUM AND ITS ALLOYS IN CARBON DIOXIDE EITHER PURE OR MIXED WITH WATER VAPOUR, AIR OR OXYGEN [INFLAMMABILITE DU MAGNESIUM ET DE SES ALLIAGES DANS LE GAZ CARBONIQUE ET SES MELANGES AVEC LA VAPEUR D'EAU, L'AIR OU L'OXYGENE]
Pierre Baque, Claudine Chevilliard, and Raymond Darras Sep. 1964 17 p refs In FRENCH; ENGLISH summary
(CEA-R-2494) CFSTI: HC $1.00/MF $0.50

Whereas low contents of metallic additions have only a small influence on the temperature at which magnesium begins to burn in carbon dioxide, an increase in the specific surface area of the samples is likely to reduce it considerably, the self-heating phenomena being then more pronounced. On the other hand, the exact nature of the surrounding atmosphere is a very important factor; thus the temperature at which ignition begins increases with increasing carbon dioxide pressure, decreases very rapidly when the moisture content of this gas increases up to 3000 v.p.m., and decreases regularly when the partial pressure of air or oxygen increases. Author

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N65-32399*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

IMAGE DISSECTOR APERTURE GEOMETRIES AND SCAN PATTERNS FOR USE IN STAR TRACKER SYSTEMS

Fred H. Shigemoto and Bruce H. Dishman Washington, NASA, Sep. 1965 34 p refs

(NASA-TN-D-2990) CFSTI: HC $2.00/MF $0.50 CSCL 01A

A study was made of different aperture geometries which could be placed at the electron image plane of an image dissector tube to derive electrical signals of star position relative to the optical axis. In comparison to the conventional image dissector tube with circular aperture and circular scan, it was anticipated that improved signal linearity, reduced cross coupling, and a star presence signal could be achieved and that the major complexity of deriving position information could be included in the reticle geometry rather than in the electronic circuitry. The aperture geometry in conjunction with the lissajous figure formed by the deflected electron beam is the basis of position detection by means of an image dissector. To avoid the expense and delay of manufacturing a series of modified tubes, a simulation of the internal operation of the image dissector was devised. This simulator was used to test a number of different combinations of aperture and scan pattern. The tests validated the simulation procedure and showed the saw-toothed reticle to be superior to the others tested. An actual tube with a saw-tooth reticle was then manufactured and the improved performance was as expected. Author

N65-32423* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

A SCIENCE INSTRUMENT SUPPORT SCANNING PLATFORM

S. Szirmay *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 54–56 ref (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

The platform subsystem is comprised of the sensor, controller, and actuator. Its performance will be optimized in terms of sensitivity, pointing accuracy, and ability to follow preprogrammed instructions. A block diagram of the platform subsystem is shown. Studies of the sensor have shown that the use of the infrared horizon in determining the local vertical is superior to other methods. Sensor systems using the infrared horizon have been built and flown successfully. Two alternate methods of mechanizing the controller-motor blocks are shown. The proposed mechanization of the horizon scanner is such that the error, which is the difference between the reference angle and the actual angle, is sampled each 100 msec and held with a zero-order hold. A model for the dynamics of the horizon scanner is also shown. E.E.B.

N65-32447* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

FURTHER ANTENNA PATTERN MEASUREMENTS IN THE 13-mm MICROWAVE BAND ON THE GOLDSTONE SPACE COMMUNICATIONS STATION 30-ft ANTENNA

M. L. Kellner *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 192–195 (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

Azimuth and elevation antenna patterns were obtained to evaluate the feed-antenna combination for beamwidth, symmetry, and sidelobe structure information. Patterns were also rerun at the frequencies and on-axis feed position used during the radiometric observations of Venus to refine the values obtained at that time. The first step in the measurement procedure was to properly focus the feedhorn on the antenna. This was accomplished at 23.8 Gc by observing the on-axis feed position yielding maximum output consistent with lowest sidelobes and symmetry from the radiometer when the antenna was pointed at the boresight bench. All power levels and the radiometer performance were carefully monitored during measurements. With the feed locked in position, the antenna was computer controlled to scan in both elevation and azimuth at a rate of 0.005° per sec. The recorder was operated at a 60-mm/min rate, yielding a calibration of 0.005°/mm on the chart. The patterns obtained are shown and the main characteristics are summarized. E.E.B.

N65-32460* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

LOW-NOISE AMPLIFIERS

C. T. Stelzried, W. V. T. Rosch, and M. S. Reid *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 245–253 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

A radio telescope consisting of a 60-inch antenna and a superheterodyne radiometer was constructed and used to observe the 90-Gc temperature of the Moon. Data from 71 observations of the Moon during the total lunar eclipse were reduced. The block diagram of the millimeter radiometer is shown. Also, the equivalent input noise temperature derivation for a cryogenic cooled waveguide termination is reviewed. The effects of barometric pressure, ambient temperature, frequency, and dielectric and waveguide wall conduction were taken into account. Further, a description is given of a compact, precision waveguide liquid nitrogen cooled termination to be used primarily in the laboratory for calibration and evaluation of traveling wave maser amplifiers. The insertion loss measurements of the waveguide components were made to a probable error on the order of 0.001 dB. E.E.B.

N65-32462* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

OPTICAL COMMUNICATIONS COMPONENTS

W. H. Wells *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 254–258 (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

Shape, frequency, and output coupling of the normal modes of an optical resonator consisting of two tilted plane mirrors were studied. The pertinent modes are thin fringes close to the pair of opposing mirror edges that are spread apart by the tilt. This resonator is especially suited for intercepting a molecular beam with optical gain in the far infrared and for providing an oscillation with output coupling in the form of radiation which spills over the edge of the shorter mirror. Results are discussed and data are presented. E.E.B.

N65-32463* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

ANTENNAS FOR SPACE COMMUNICATIONS

A. Ludwig *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 258–266 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

The change rate of gain loss due to phase errors with respect to frequency was investigated as a function of total gain loss. The upper limits of this rate of change are predicted and related to the physical deformations in the system. Also, the theoretical limits on the performance of multimode feed

horns was studied and the current state-of-the-art in experimentally realized multimode horn patterns is reviewed. It is shown that performance maxima approach very closely theoretical limits for any type of feed device of the same size, indicating that conical feedhorns are potentially ideal. A four-mode horn pattern was experimentally realized yielding an efficiency 4% above the best existing feed and 7% below the theoretically optimum pattern. It is considered that an additional 4% might be obtained with further research effort. E.E.B.

N65-32470* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MINIMIZING VCO NOISE EFFECTS IN PHASE-LOCKED LOOPS
R. C. Tausworthe *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 287–289 (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

A model is presented for voltage controlled oscillator noise which agrees with the observed behavior of actual voltage controlled oscillators. Fundamental loop behavior; the effects of oscillator noise, and the optimization of the oscillator parameters are considered. As an example a typical design problem for an Earth-spacecraft link at the distance of Mars is solved. E.E.B.

N65-32471* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
OPTIMAL DESIGN OF ONE-WAY AND TWO-WAY COHERENT COMMUNICATION LINKS
W. C. Lindsey *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 290–296 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

A two-way communication link is considered and the design trends are specified which will enable a design engineer to arrive at the optimal choice of parameters. Error probability versus modulation index for one-way and two-way links; optimized performance characteristics for one-way and two-way links; and output signal-to-noise ratio for one-way links are given. Also optimized performance characteristics for one-way coded links are shown. E.E.B.

N65-32676 Library of Congress, Washington, D. C. Aerospace Technology Div.
GIANT RADIO TELESCOPE
Stuart G. Hibben *In its* Foreign Sci. Bull., Vol. 1, No. 8 Aug. 1965 p 1–8 refs (See N65-32675 21-34)

One of the largest radio telescopes in the world is nearing completion at the Radioastronomical Laboratory of Fian, located near Moscow. The telescope is a Mills cross using parabolic cylinder antennas, and is designed to detect extraterrestrial radiation in the 2.5–10-meter wavelengths. Details of the construction and the exciter and feed system design are given, as well as of the beam positioning methods for both the fixed and rotatable antenna arms. Author

N65-32690# Illinois Univ., Urbana. Dept. of Electrical Engineering.
STUDY AND INVESTIGATION OF MILLIMETER AND SUBMILLIMETER WAVE RECEIVER TECHNIQUES Sixth Quarterly Report, 10 Oct.–31 Dec. 1964
J. R. Baird, J. E. Degenford, and E. Yamashita Griffiss AFB, N. Y., RADC, Jun. 1965 26 p refs
(Contract AF 30(602)-3046)
(RADC-TR-65-127; AD-618036)

This program has as its goal the development of video and superheterodyne detection techniques which are appropriate for the millimeter and submillimeter range of the spectrum. A theoretical method of analysis of a tunnel diode in a waveguide is developed and the results are correlated with experimental data of other experimentors. Results are given for twelve loop detectors which were tested at 4mm and for an X-band model. Author

N65-32711# Philco Corp., Blue Bell, Pa.
NON-PLANAR ARRAY "THINNING" STUDY Third Interim Technical Report, 16 Oct.–31 Dec. 1964
Charles E. Clarke and Thomas J. B. Shanley Griffiss AFB, N. Y., RADC, Apr. 1965 71 p refs *Its* Rept.-2594-3
(Contract AF 30(602)-3337)
(RADC-TR-65-19; AD-618102)

Development of generally applicable analytical approximations for the means and variances of the probability density functions for the quadrature components of the field. Previous work had developed estimates valid only for small angles off the main beam. Development of analytical expressions for: (a) the probability density function of sidelobe magnitude anywhere in the pattern, (b) the mean-squared far sidelobes, (c) the probability density function of the 3-db beamwidth, and (d) the sidelobe magnitude not exceeded anywhere in the far sidelobes with a specified assurance. These expressions are all functions of the degree of thinning and of element directivity. Completion of a comprehensive set of computer simulation runs from which ten, independent sample patterns are available for each of several array designs featuring different degrees of thinning and different element directivity characteristics. Preliminary examination of the agreement between the analytical predictions and the computer results. Author

N65-32775# National Physical Lab., New Delhi (India). Radio Propagation Unit.
IONOSPHERIC EFFECTS OF NUCLEAR EXPLOSIONS. PART II: HIGH ALTITUDE EXPLOSIONS
A. K. Saha and K. K. Mahajan 15 Mar. 1965 32 p refs (RPU-S-20) CFSTI: HC $2.00/MF $0.50

Part II of this series of reports describes ionospheric effects observed at Delhi following 3 Russian high altitude nuclear explosions in Central Asia and 2 high altitude explosions over Johnston Island by the U.S.A., during October-November 1962. The observations were made with various ionospheric equipments that were in routine operation at this Laboratory as a part of regular ionospheric studies. The major effects were noted on long wave field strength records of Radio Tashkent (164 Kc/s) and cosmic radio noise records at 22.4 Mc/s and a C4 ionosonde. No effects could be observed with atmospherics recorders at 27 Kc/s and 100 Kc/s. The effects noted were significantly different from those following megaton range Novaya Zemla explosions, reported in Part I of this series. The possible modes of propagation of the D region and F region effects noted for both the central Asia and Johnston Island explosions are discussed. Author

N65-32819# Joint Publications Research Service, Washington, D. C.
NEW RADIO TELESCOPE PROPOSED FOR BYURAKAN OBSERVATORY
7 Sep. 1965 6 p Transl. into ENGLISH from Nauka i Zhizn' (Moscow), no. 6, Jun. 1965 p 86–87
(JPRS-31887; TT-65-32381) CFSTI: $1.00

Plans are announced for construction of a radio telescope with a pencil beam antenna which is expected to afford sharp directional diagrams and capability to detect weak signals. The principal reflector is spherical with 100-meter diameter, and will remain in fixed position while a smaller mirror can be deflected 55° in any direction from the main axis. The antenna is designed to receive waves in the millimeter-to-meter range, and offers rapid automatic pointing at any particular sector of the sky, and highly accurate automatic tracking of emission sources. J.M.D

N65-32832# Atomics International, Canoga Park, Calif.
COHERENCE MEASUREMENTS
R. L. Randall 23 Apr. 1964 20 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9841)

An introduction to frequency response measurements and the mathematical concept of coherence is presented. Electronic instruments are described which perform frequency response and coherence measurements of a system or process relating a random excitation signal and a noise contaminated response signal. The coherence function represents the fractional portion of a noise contaminated signal which is statistically correlated with, or linearly dependent upon, a particular random excitation signal at each frequency. A series of tests using various combinations of the output signals from two random noise generators were conducted to demonstrate the mathematically correct performance of the proposed system for calculating coherence. The results verified that the coherence output of the analyzer was directly proportional to the fraction of an observed response signal from a system under test which was statistically correlated with an observed excitation signal at each frequency. R.N.A.

N65-32867*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE DEEP SPACE NETWORK, VOLUME III SPACE PROGRAMS SUMMARY, 1 MAY–30 JUN. 1965
31 Jul. 1965 72 p refs
(Contract NAS7-100)
(NASA-CR-64631; JPL-37-34, Vol. III) CFSTI: HC $3.00/MF $0.75 CSCL 17B

Tracking stations engineering and operations and communications engineering, research, and development for the Deep Space Network are reviewed. An advance antenna system, the Madrid antenna erection, and modifications to the Az-El antenna are considered. A study of amplifier drift effect on tracking accuracy and a gear box lubricant experiment are reported. The digital instrumentation system, composed of SDS 910 and 920 computers and associated peripheral and data-gathering equipment, is detailed. Subsystem update and extension as well as communications buffers are discussed. Engineering developments deal with S-band implementation, Mariner C occultation, cassegrain monopulse cone assemblies, FM telemetry, and RF voltage controlled oscillator. Subjects of research and development experiments include a closed cycle refrigerator for masers, X-band lunar radar, Venus station operations, an S- and X-band central frequency synthesizer, and data systems. M.W.R.

N65-32895# Bölkow Entwicklungen K. G., Munich (West Germany).
ON FUNDAMENTAL LIMITATIONS OF THE PERFORMANCE OF COMMUNICATION CONTACTS IN SPACE TRAVEL [ZUR FUNDAMENTALEN LEISTUNGSGRENZE VON NACHTRICHTENVERBINDUNGEN MIT RAUMFAHRTZEUGEN
Johannes Peters [1965] 27 p refs Presented at the DGRR Symp. "Datenübertragung und Navigation im Weltraum" Munich, 8 Apr. 1965 CFSTI: HC $2.00/MF $0.50

Production of information demands a certain minimum energy that is proportional to the absolute temperature. Realistic communications systems are limited to about 10^9 to 10^{10} bits per second, since every bit of information requires at least 5×10^{-23} watt/sec of energy. Future technical progress to lower this limitation seems remote under the laws of thermodynamics. An energy of 5×10^{-22} watt for an information flow of 10 bits per second can reach the utmost distance of about 1.14×10^{13} km under ideal conditions; this value corresponds to somewhat more than one light year. Since the radius of our galaxy is about 50 000 light years, communications possibilities with other planet systems seem unrealistic.
Transl. by G.G.

N65-32950*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
SATELLITE TRACKING AND DATA ACQUISITION NETWORK FACILITIES REPORT (STADAN)
Jun. 1964 157 p
(NASA-TM-X-55026; X-539-64-159) CFSTI: HC $5.00/MF $1.00 CSCL 17I

The functions and facilities of the three major systems which comprise the Satellite Tracking and Data Acquisition Network (STADAN) are described. These systems are (1) Minitrack, used to track satellites containing suitable beacons, and for receiving telemetry data in the 136 to 137 megacycle and 400 to 401 megacycle bands; (2) the transportable range and range-rate tracking system, used to complement the Minitrack network by providing improved tracking data for space probes, launch vehicles, and satellites in highly elliptical orbits; and (3) the Data Acquisition Facilities (DAF) used to handle large quantities of data at high rates, and equipped with multifrequency, high-gain antennas. Analyses of network coverage are included, and the major capabilities of the network are summarized. M.G.J.

N65-32954*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
RADIO VISIBILITY—ANTENNA LOOK ANGLE FORMULATION FOR AN APOLLO ATMOSPHERIC ENTRY
Jerry S. Linnekin May 1965 20 p refs
(NASA-TM-X-55284; X-513-65-208) CFSTI: HC $1.00/MF $0.50 CSCL 17I

The formation of the antenna look angle, δ_{ij}, which is defined as the angle between the axis of propagation of a vehicle-borne antenna and the negative of the line of sight vector from an arbitrary radar station is presented in this paper. The application of this angle to "radio visibility" during entry is described and results from a guided Hawaiian entry are shown. Other applications of the technique are discussed. From this look angle and the assumed half cone angle of the vehicle antenna radiation pattern, it is possible to predict whether the vehicle is "radio visible" at a tracking site or not. Author

N65-33122# Stanford Research Inst., Menlo Park, Calif.
COMPARISON OF HF PROPAGATION PREDICTIONS AND OBLIQUE-INCIDENCE SOUNDER OBSERVATIONS ON THE OKINAWA/OAHU CIRCUIT
Richard R. Bartholomew Dec. 1964 40 p refs
(Contract DA-28-043-AMC-00082(E))
(IR-2; AD-617361)

The propagating frequencies predicted by the United States Army Signal Radio Propagation Agency (RPA) are compared with frequencies observed by an oblique-incidence sounder circuit paralleling the communication trunk. Predictions derived from the world-wide frequency predictions made by the National Bureau of Standards Central Radio Propagation Laboratory (CRPL) are also compared with the sounder-observed frequencies. The predicted maximum usable frequency (MUF) is compared with the monthly median of the observations for three months, and the predicted lowest usable frequency (LUF) is compared with the monthly median of the observations for two months. In addition, the observations on the Controllers Data Display (CDD) are compared with observations on film records and found to be in good agreement. It is shown that neither the RPA or the CRPL MUF predictions truly represent median conditions on this trunk. The LUF predictions are found to be representative of median conditions but with a slight tendency to be higher than the observations. Author

N65-33144*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-34, VOLUME III FOR THE PERIOD MAY 1, 1965 TO JUNE 30, 1965. THE DEEP SPACE NETWORK
31 Jul. 1965 72 p
(Contract NAS-7-100)
(NASA-CR-64589; JPL-SPS-37-34, Vol. III) CSCL 17B

Tracking stations engineering and operations, communications engineering development, and communications research and development for the Deep Space Network are described. Research and development activities are included on the Goldstone operations, advanced antenna system, Madrid 85-ft antenna erection, modifications to the 30-ft Az-El antenna, study of amplifier drift effect on tracking accuracy, gear box lubricant experiment, digital instrumentation subsystem, S-band implementation for the Deep Space Instrumentation Facility, ground instrumentation for Mariner C occultation experiment, S-band Cassegrain monopulse cone assemblies, 50-Mc intermediate frequency amplifier (FM telemetry), RF voltage controlled oscillator development, experimental closed cycle refrigerator for masers, experimental X-band lunar-planetary radar project, X-band lunar radar transmitter, X-band lunar radar, Venus station operations, frequency generation and control, and efficient data systems. R.N.A.

N65-33146*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER II TRACKING SYSTEM Final Data Analysis Report
W. D. Chaney 1 Sep. 1965 66 p
(Contract NAS7-100)
(NASA-CR-64610; JPL-TR-32-727) CFSTI: HC $3.00/MF $0.75 CSCL 17I

The analysis of the Deep Space Instrumentation Facility spacecraft tracking performance during *Mariner II* is summarized. Included are: (1) the ground system configurations; and (2) a summary of tracking histories and tracking performances during scheduled premidcourse, midcourse and postmidcourse view periods. Tracking data used to determine the spacecraft orbit are also summarized. Author

N65-33148*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE EFFECT OF THE INTERPLANETARY MEDIUM ON S-BAND TELECOMMUNICATIONS
M. Easterling and R. Goldstein 1 Sep. 1965 14 p refs
(Contract NAS7-100)
(NASA-CR-64612; JPL-TR-32825) CFSTI: HC $1.00/MF $0.50 CSCL 17B

The space within our solar system, which is normally thought of as being empty, we know, in reality, is not, although it is extremely tenuous. Consideration of the accumulated effects on microwave signals traveling through many millions of miles of space becomes important. Mechanisms have been theorized for the generation of multipath, rotation of polarization, deflection, attenuation, and other telecommunication problems in space. There is no a priori way of assessing the magnitude of the effects of the interplanetary medium on telecommunications. However, since the advent of radar astronomy, we have a method of measuring these influences under the actual conditions of interest. The medium has been tested by sending waves through it, then analyzing the echoes reflected from the planets. The techniques used and the results obtained at S-band over a considerable area of the plane of the ecliptic are described in this paper. Author

N65-33172# Federal Aviation Agency, Atlantic City, N. J. Systems Research and Development Service.
HAZELTINE SLATE III AND SLATE III MARK I TRANSPONDERS
George H. Mahnken and Paul A. Todd Jul. 1965 19 p ref
(RD-65-81)

A description is given of the transponders, and of the test equipment and procedures used. Only laboratory bench tests were performed. Marginal side lobe suppression and poor echo suppression over the required dynamic range of the receiver were the major deviations. The transponders are considered to be acceptable except for the deviations noted. Author

N65-33173# Federal Aviation Agency, Atlantic City, N. J. Systems Research and Development Service.
EVALUATION OF VHF AIR-GROUND FIXED-TUNED RECEIVER TYPE RV-13X Final Report
James G. Dong Jun. 1965 31 p refs
(RD-65-80)

Laboratory tests were conducted at the Federal Aviation Agency (FAA), National Aviation Facilities Experimental Center (NAFEC), Atlantic City, New Jersey, on a VHF Air-Ground Fixed-Tuned Receiver, Type RV-13X, to determine its suitability for FAA use. Measurements were made of such operating parameters as: noise figure, sensitivity, selectivity, and desensitization. Based on the results of the evaluation, it was concluded that although the receiver provided an improvement in noise figure and sensitivity at the receiver midband frequency (127 mc), the unit as designed was unsuitable for FAA use due to its susceptibility to undesired responses, instability, and inability to provide required selectivity characteristics above to 60 db skirt. It was recommended that the Receiver not be adopted for FAA use. Author

N65-33180*# Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.
RANGER TV SUBSYSTEM (BLOCK III). VOLUME 1: SUMMARY Final Report, Jul. 1961–Jul. 1965
22 Jul. 1965 90 p Prepared for JPL
(Contract JPL-950137)
(NASA-CR-64788; AED-R-2620) CFSTI: HC $3.00/MF $0.75 CSCL 17B

The conception and refinement of the television subsystem for the Ranger missions is summarized. This subsystem, known as the split-system, has a maximum degree of redundancy of both signal and power paths. Also, due to the transmission failure in Ranger VI, this modified concept was required to offer capability of performing under conditions of partial failure within the subsystem. The split-system was incorporated into Ranger VI. Topics in this report are the subsystem project organization, history of contractual activities, television subsystem design, design of operational support equipment, and summaries of Ranger missions VI through IX. J.M.D.

N65-33181*# Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.
RANGER TV SUBSYSTEM (BLOCK III). VOLUME 2: SUBSYSTEM ANALYSIS Final Report, Jul. 1961–Jul. 1965
22 Jul. 1965 75 p Prepared for JPL
(Contract JPL-950137)
(NASA-CR-64793; AED-R-2620) CFSTI: HC $3.00/MF $0.75 CSCL 17B

Detailed analyses involved in the development of the television subsystem for the Ranger missions are presented. The fundamental problems of lunar imaging and cislunar communications are discussed. The feasibility of retrieving the video data from the cameras at the cislunar distance is established. Considerations behind choice of standard frequency-modulation for the communications system are given. The

signal/noise ratios of the imaging and communications systems are combined to predict the signal/noise ratio for the entire subsystem. Automatic versus fixed methods of exposure and gain control are considered. Development of the vidicon scanning rates is discussed as well as the selection of the number of cameras and the camera-pointing array. The design of the power supply, thermal control, and the subsystem structure are discussed in relation to the overall television subsystem configuration. J.M.D.

N65-33182*# Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.
RANGER TV SUBSYSTEM (BLOCK III). VOLUME 3: TV SUBSYSTEM DESIGN Final Report, Jul. 1961–Jul. 1965
22 Jul. 1965 405 p Prepared for JPL
(Contract JPL-950137)
(NASA-CR-64789; AED-R-2620) CFSTI: HC $7.00/MF $2.00
CSCL 17B

Development activities and final design of various components of the television subsystem for the Ranger missions are described. Specific topics are the cameras, control programmers and camera sequencers, and radio altimeter; telecommunications group to assure acquisition of television data of the lunar surface, engineering telemetry data, and scientific telemetry data from on-board experiments; controls group to provide real-time operation of the subsystem according to a prearranged plan for experimentation; power group to equip the subsystem with power source, regulation, and distribution independent of the spacecraft power system; thermal group for controlling heat and gaining temperature histories of the separate subsystem modules; structure group to house the cameras, provide adequate strength and rigidity for environmental conditions, and offer compatibility with spacecraft design; and the operational support equipment for television data recovery. J.M.D.

N65-33185*# Radio Corp. of America, Princeton, N. J. Astro-Electronics Lab.
RANGER TV SUBSYSTEM (BLOCK III). VOLUME 5: EVALUATION Final Report, Jul. 1961–Jul. 1965
22 Jul. 1965 152 p Prepared for JPL
(Contract JPL-950137)
(NASA-CR-64792; AED-R-2620) CFSTI: HC $5.00/MF $1.00
CSCL 17B

Performance of the television subsystem is evaluated for Ranger missions VII, VIII, and IX. The evaluation covers prelaunch, launch, cruise mode, and terminal mode, and includes analysis of real-time data and the performance of the equipment for the flight models preceding each mission. The use of mechanical, engineering, thermal control, life, and proof test models in designing and refining the subsystem is discussed. These models, used in conjunction with reliability and quality assurance testing, are given considerable credit for the successful implementation of the television subsystem. J.M.D

N65-33186*# Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.
RANGER TV SUBSYSTEM FLIGHT EVALUATION REPORT FOR FLIGHT MODEL III-4 (RA-9)
15 Jun. 1965 160 p Prepared for JPL
(Contracts NAS7-100; JPL-950137)
(NASA-CR-64797; AED-R-2692) CFSTI: HC $5.00/MF $1.00
CSCL 17B

An evaluation of the performance of Flight Model III-4 of the Ranger TV subsystem during testing preceding the launch of Ranger IX and during the Ranger IX mission is presented. Several modifications incorporated in Flight Models III-3 and III-4 which distinguish these TV subsystems from the Ranger VII TV subsystem, are described. The Ranger IX mission and the realtime data obtained and evaluated during the mission are described. An evaluation of the individual groups of equipment that comprised the Ranger IX TV subsystem is presented. This equipment is evaluated in relation to information obtained during the mission. The performance of the Ranger IX TV subsystem met or exceeded all mission objectives. The appendices contain a test history, prelaunch testing, and a summary of malfunction reports for the Flight Model III-4. R.N.A.

N65-33200# Joint Publications Research Service, Washington, D. C.
A REVIEW OF SOVIET ACHIEVEMENTS IN RADIO ENGINEERING
A. D. Fortushenko 14 Sep. 1965 10 p Transl. into ENGLISH from Radiotekhn. (Moscow), vol. 20, no. 5, 1965 p 5–9
(JPRS-31992; TT-65-32486) CFSTI: $1.00

The progressive use of electronic and radio engineering devices in agriculture, medicine, geological prospecting, weather forecasting, space satellites, and space instruments is reviewed. In April 1965, television programs were exchanged between Vladivostok and Moscow via the communication satellite Molniya-1. New types of radio relay equipment with increased carrying capacity designed to operate in different frequency ranges are being developed. A tropospheric communications system in a new frequency range that will transmit more telephone and television channels is also under construction. More than 90 000 000 people live in an area of good television reception, and the Soviet population is indicating great interest in television. In 1965, the number of television sets was 13 000 000 as compared to only 450 000 in 1955. The transition from experimental color TV broadcasts to more extensive use of color TV is contemplated. R.R.D.

N65-33207# Library of Congress, Washington, D. C. Aerospace Technology Div.
RADIO ASTRONOMY ANTENNAS AND PROCESSING OF RADIO ASTRONOMY DATA Surveys of Soviet Scientific and Technical Literature
13 Sep. 1965 19 p Compilation of Abstracts
(ATD-P-65-67)

Abstracts of 48 Soviet papers concerning developments in radio astronomy antennas and processing of radio astronomy data are presented. J.M.D.

N65-33208# Federal Aviation Agency, Washington, D. C. System Design Team.
RADIO-INTERFERENCE PROBABILITY AND ITS EFFECT ON SITE-SEPARATION STANDARDS AND FREQUENCY ASSIGNMENT OF VHF AND UHF CHANNELS
Alfred J. Hoehn Aug. 1965 51 p refs
(RD-65-91)

The factors contributing to the probability of Air Traffic Control radio interference by vhf and uhf channel assignments are reported. Also a mathematical model is established which permits computation of the effect of the various probabilities on the overall interference picture, and consideration is given to methods of frequency assignment. A recommendation is made that greater emphasis be placed upon the probability of utilization in frequency assignment, and much less upon the concept of air-to-air protection through distance separation. The reexamination of directive ground antenna use in ground-to-air protection is recommended as a factor of prime importance. Frequency block assignment according to Air Traffic Control function was also deemed helpful. W.M.R.

N65-33216# Martin Co., Denver, Colo. Aerospace Div.
SSLV NO. 4 ELECTROMAGNETIC INTERFERENCE Test Report
P. C. Crissman [1964] 57 p refs
(Contract AF 04(695)-150)
(SSD-CR-64-225; AD-461446)

Results of the electromagnetic interference compatibility tests performed on the basic Titan III-A system are reported. The purpose of the tests was to verify certain electrical safety margins, and to verify fixes previously applied to the vehicle as a result of radio frequency interference problems. Results of the radio frequency tests showed that the mesh screen placed on top of the transtage provided approximately 20 db attenuation to the rf fields created by the telemetry system. The attenuation was shown to be sufficient to bring flight control system parameters within specification, so far as offset due to noise was concerned. Other testing indicated the 6 db safety margin required, and showed that the vehicle subsystems were operating normally. W.M.R.

N65-33217# Lincoln Lab. Mass. Inst. of Tech., Lexington.
SEQUENTIAL DECODING ON A CHANNEL WITH SIMPLE MEMORY
J. E. Savage 2 Apr. 1964 24 p refs *Its* Group Rept. No. 1964–5
(Contract AF 19(628)-500)
(ESD-TDR-64-42; AD-437163)

A model for a binary channel with additive Markovian noise is presented. The behavior of the sequential decoding cutoff rate, R_{comp}, for this channel is studied under various degrees of memory. It is shown that R_{comp} decreases from its memoryless value whereas channel capacity increases when errors begin to cluster. This apparent paradox is explained and the small-memory deterioration in R_{comp} is shown to be correctable by elimination of the channel memory through scrambling. This study should serve primarily as an instrument for understanding the effects of memory on sequential decoding. Author

N65-33224*# Hallicrafters Co. Chicago, Ill.
STUDY OF COMMUNICATIONS SYSTEMS, AND DETECTION AND TRACKING SYSTEMS. DESIGN AND FABRICATION OF DYNAMIC CROSSED-FIELD ELECTRON MULTIPLYING LIGHT DEMODULATOR Periodic Progress Report No. 3, 20 Sep.–20 Dec. 1964
M. Ross, R. Hankin, E. Dallafior, and R. Swendsen [1964] 64 p refs
(Contract NAS5-3777)
(NASA-CR-64774) CFSTI: HC $3.00/MF $0.75 CSCL 17B

This report presents results of an optical communications and tracking systems program divided into three specific Tasks as follows: Task I: Analyze laser communications, detection, and tracking systems; Task II: Disseminate the results of Task I through a lecture series; and Task III: Develop a microwave bandwidth dynamic crossed-field electron multiplier demodulator. Task I results include a detailed analysis of optical receiving techniques. Direct photodetection and photomixing are examined. Aspects of photomixing are presented, including spatial requirements of photomixing, local oscillator power requirements, and the present status of photomixing. Task III results consisted of evaluation of factors affecting detector life and in obtaining experimental data on DCFEM operation. A relatively stable detector has been produced that exhibits high current gain and good frequency response. This tube was operated without an auxiliary vacuum pump after being "tipped off" from the pump station. The operating life of this tube was 100 hours. After this time internal gassing decreased cathode response by almost two orders of magnitude. Author

N65-33233# Montana State Coll., Bozeman. Electronics Research Lab.
STUDIES OF COMPLEX COMMUNICATIONS PROBLEMS: ANTENNA MATCHING NETWORKS Final Report
John Duncan Dec. 1964 96 p refs
(Contract N123(953)51311A)
(ERL-8-0009-641; AD-462888)

The objective of this report is to outline a synthesis procedure for generating a passive matching network which will transform a given set of antenna source impedances so as to minimize the input VSWR over the frequency range of interest and transform its nominal impedance to that of the transmission line which will feed the antenna. First, given a set of antenna source impedance characteristics, a simple passive network is derived whose input impedance characteristics closely approximate those of the given antenna. Two techniques of obtaining an approximate antenna analog are presented and an outline of the synthesis procedure is given. A digital computer program (FORTRAN) is presented which will carry out the synthesis and analysis of the matching network. A sample calculation is followed through for a typical shipboard trussed whip antenna. Three matching networks of different complexities are synthesized which will match this antenna over an octave frequency range. The VSWR and insertion loss of each is evaluated for network inductance Q's of 200. Author

N65-33260*# Brown Engineering Co., Inc., Huntsville, Ala.
AIRBORNE RANGE AND ORBIT DETERMINATION DESIGN STUDY: VOLUMES I–IV Final Report
Dec. 1964 955 p refs
(Contract NAS8-11526)
(NASA-CR-64533; AROD-19-S-6) CFSTI: HC $12.00/MF $4.25 CSCL 17I

Presented is a four-volume report of research focusing on the design, development, assembly, testing, and evaluation, of a design model of an Airborne Range and Orbit Determination System (AROD). The AROD system was designed to determine the position and velocity of a space vehicle with the data extraction performed aboard the vehicle. The analyses and decisions involved in the evolution of the final design study model are discussed, and the overall AROD system and its subsystems are described. Also presented are results of laboratory and aircraft flight test programs and a complete index of all documentation. The entire study is summarized and evaluated in terms of the definition of the system design suggested for the next phase of the program. S.C.W.

N65-33280*# Illinois Univ., Urbana. Electrical Engineering Research Lab.
PARAMETER DEPENDENCE OF PHASE AND LOG AMPLITUDE SCINTILLATION
J. F. Phelan and K. C. Yeh 30 Jun. 1965 20 p refs
(Grant NsG-24-59)
(NASA-CR-64809) CFSTI: HC $1.00/MF $0.50 CSCL 20N

By means of numerical computation based on the equations developed by Yeh [1962] for phase and log amplitude correlation of waves transmitted through a slab of random irregularities, the effects of variations in transmitter height, slab thickness, slab height and irregularity size are studied. A selected number of curves illustrating the effects of changes in these parameters are drawn. Using these curves as a basis, it is shown that, from experimental data, bounds may be established for some of these parameters. Author

N65-33283*# Michigan Univ., Ann Arbor. Radiation Lab.
APPLICATION OF CONFORMAL MAPPING TO SCATTERING AND DIFFRACTION PROBLEMS
Soonsung Hong Jun. 1965 84 p refs /ts Rept.-5780-6-T (Grant NsG-444)
(NASA-CR-64814) CFSTI: HC $3.00/MF $0.75 CSCL 20C

The scattering and diffraction of a plane electromagnetic wave which is normally incident on a perfectly conducting infinite cylinder in a homogeneous isotropic medium and which is polarized parallel to the cylinder axis is studied. In particular, an approximation method is devised for solving the scalar wave equation which satisfies both the radiation condition at infinity and the assumption that the boundary of the cylinder has a continuous tangent everywhere. The method involves conformal mapping to obtain approximate far field expressions for scattered and diffracted waves for more general cylinder cross-section shapes than are available from exact methods. J.M.D.

N65-33301# Chu Associates, Littleton, Mass.
DEVELOPMENT OF A LOG-PERIODIC VHF/ECM ANTENNA First Quarterly Progress Report, 29 Jun.–5 Oct. 1964
Charles F. Reichert [1964] 20 p
(Contract DA-28-043-AMC-00258(E))
(Rept.-1; AD-468707)

This report describes the design of a log-periodic VHF/ECM antenna capable of receiving or transmitting electromagnetic signals in the frequency range of 20–230 mc. The antenna is a planar log-periodic type, incorporating capacitive and inductive loading in its elements. Prime objective of the design is to provide the electrical performance characteristics of an unloaded planar log-periodic antenna in an antenna having minimum size, minimum weight, maximum reliability, and ease in field assembly and disassembly. Work performed to date indicates these objectives will be met with the exception of the weight being greater than the 35 lb. limit specified in SCL-5994. Author

N65-33321# Philco Corp., Blue Bell, Pa. Aeronutronic Div.
IMPROVED AZIMUTHAL RESOLUTION WITH A FORWARD LOOKING RADAR Final Technical Report, 1 Jul. 1964–30 Jun. 1965
J. Merritt, L. Miamidian, S. Urban, J. Koval, and R. Thompson 16 Aug. 1965 198 p refs
(Contract NOw-64-0602-f)
(Rept.-2600-F; AD-470128)

Methods are presented for improving the azimuthal resolution of a forward looking radar. Digital methods applied to delay line processing provide real time focused synthetic aperture resolution improvements in the forward hemisphere of the aircraft. An analysis of motion compensation errors showed progressively poorer performance as the squint angle moves closer to the ground track. Additional terms, not normally considered in the side looking case, become the limiting factors, particularly at small squint angles, when the principal error term is prefectly corrected by an ideal motion compensation technique. The use of simple clutter lock methods for motion compensation are not able to provide sufficient corrections when resolutions higher than 1 milliradian are required at squint angles within 10 degrees of the ground track. The use of in-phase and quadrature storage of radar data in a focused electronic processor was justified by laboratory tests using simulated signals. It was shown that spurious video foldover terms, which normally degrade resolution, are cancelled, and that there is a processed output regardless of signal phase. R.N.A.

N65-33379# Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.
DRIVING POINT IMPEDANCE OF LINEAR ANTENNAS IN THE PRESENCE OF A STRATIFIED DIELECTRIC Scientific Report No. 7
Janis Galejs Apr. 1965 34 p refs
(Contract AF 19(628)-2410)
(RR-445; S-3040-7; AFCRL-65-372; AD-618397)

A linear flat strip antenna lies between several dielectric layers in a direction parallel to the interfaces. Its impedance is formulated variationally as an infinite double integral. For thin half-wave antennas in a homogeneous medium the double integral is evaluated analytically and it gives standard impedance expressions. For antennas of finite width the integrals are evaluated numerically and for a homogeneous medium the impendance has been correlated with the theories of King, Middleton, and Wu, with the impedance computed from a complementary slot antenna and with available measurements. The impedance is also computed for antennas in a dielectric layer, and the decrease of the radiation efficiency observed with increasing electrical thickness of the layer is explained with the increased amounts of surface wave power and in part by local dielectric losses. For insulated antennas located in a dissipative medium the theory presented here yields results in better agreement with measurements than the conventional transmission line theory. Author

N65-33380# Rome Air Development Center, Griffiss AFB, N. Y. Communications Techniques Branch.
SOME ASPECTS OF FM DESIGN FOR LINE-OF-SIGHT MICROWAVE AND TROPOSCATTER SYSTEMS Final Report
R. L. Marks, F. Zawislan, J. Mc Clure, and R. Fellows, Jr. Apr. 1965 192 p refs
(RADC-TR-65-51; AD-617686)

The purpose of this report is to discuss those elements of system design that influence the performance of troposcatter and microwave line-of-sight systems. The material is presented in a continuous manner in order to effect an appreciation and understanding of the significance of the various design variables and to reveal the relationship of the variables with respect to the overall system design objectives. The effects of the transmission media are also discussed and presented simply as one additional element in the overall design problem. This report also consolidates the various applicable equations, curves, discussions and nomographs that are now in other selected reports and studies. The National Bureau of Standards' method of predicting circuit performance is discussed. A number of representative problems are analyzed. The report discusses further various FM receiver and transmitter parameters, system noise objectives, standards and propagation equations for troposcatter and microwave line-of-sight (LOS) operation. Author

N65-33402# Michigan Univ., Ann Arbor Infrared and Optical Sensor Lab.
BACKGROUND ANALYSIS CENTER Summary of First Year's Work
J. Alward Jun. 1965 22 p refs
(Contract ARPA SD-91; ARPA Order 238; Proj. Defender)
(Rept.-6054-5-P; AD-468493)

Activities of the Backgrounds Analysis Center during its first year, 1 October 1963 to 1 October 1964, are summarized in this report. Reduction and analysis procedures used on data taken on two of the NOTS T-Bird Rocket flights are reported. Computational techniques useful in estimation of Fourier transforms from digitalized data are discussed. The preparation of a state-of-the-art review of high-platform, down-looking background measurements is described. A new library

retrieval system is described, and status and usage of the Backgrounds Library are summarized. Discrimination techniques concerned with reticle analysis, with sampling theory, and with spectral filtering are reported. Plans for the second contract year are discussed. Author

N65-33420# Office of Research Analyses, Hollman AFB, N. Mex.
ON AN ATMOSPHERIC DOPPLER SHIFT AND ITS RELATION TO THE GRAVIATIONAL FREQUENCY SHIFT
Bruno Manz Jul. 1965 18 p ref
(ORA-65-4; AD-469062)

The atmospheric Doppler shift occurs when emitter and receiver are mounted on a rigid bar which moves in the direction of its length axes through the earth's atmosphere. At the same time, the gravitational and—if the bar is accelerated—the accelerational frequency shifts take place. The theory of the combined action of these three effects is developed. It is shown by a numerical example that the atmospheric frequency shift can be considerably stronger than the gravitational shift. Author

N65-33422# Aberdeen Proving Ground, Md. Ballistic Research Labs.
A FEASIBILITY TEST OF A 1750 MC/S TELEMETRY AND TRACKING SYSTEM FOR FIVE-INCH HARP PROJECTILES
William J. Cruickshank May 1965 62 p refs
(BRL-MR-1651; AD-469653)

A 1750 mc/s telemetry and tracking system for the 5-inch HARP (High Altitude Research Program) projectile is described. The results obtained from two test firings at Wallops Island, Virginia, on 13 October 1964 are discussed. Author

N65-33448# Stanford Research Inst., Menlo Park, Calif.
DIGITIZING RIOMETER SYSTEM Final Report, 1 Dec. 1963–28 Feb. 1965
J. C. Hodges and G. L. Johnson Feb. 1965 26 p
(Contract AF 19(628)-409)
(AFCRL-65-154; AD-614247)

The prototype of a digitizing riometer system is described. The data are punched into paper tape, which a computer later transfers to digital magnetic tape. The computer then uses the magnetic tape to construct a quiet-day curve. The final computer output is a chart of absorption vs. time. Author

N65-33468# Navy Electronics Lab., San Diego, Calif.
SYNCHRO-TO-TAPE-TO-SYNCHRO CONVERTER
J. Marez and R. A. Turner 21 May 1965 64 p ref
(NEL-1289; AD-619052)

Describes the development of a converter that provides a simple means of encoding synchro data for recording on magnetic tape and, when used in the decoding mode, of converting coded tape data back to the original synchro form. Laboratory tests showed the equipment to function accurately and reliably. Author

N65-33487# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Optics Div.
BENEFICIAL APPLICATIONS OF THE INCOMPLETE OPTICAL RESEARCH RADIOMETRIC ANALYSIS SYSTEM [ORRAS]
Richard W. Bullard 2 Nov. 1964 22 p refs
(TM-64-5; AD-462784)

The Optical Research Radiometric Analysis System (ORRAS) development was undertaken at WSMR to provide a capability for infrared-visible-ultra violet signature measurements. Although the project was cancelled when about two-thirds complete, considerable useful equipment was produced, particularly the tracking mount. This memorandum describes the available equipment and proposes several useful applications of the incomplete ORRAS. How it can be profitably used for developing and testing various tracking techniques, perfecting TV tracking, experimenting with acquisition sights and training of tracking operators is discussed. Author

N65-33504*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
THE SCREENING EFFECT OF OBSTACLES WITH A STRAIGHT EDGE
H. Martinides 5 Jan. 1965 28 p refs
(NASA-TM-X-56786) CFSTI: HC $2.00/MF $0.50 CSCL 20N

The fundamentals of the mathematical treatment of a special diffraction problem are outlined and numerical values are presented. It was not the purpose to repeat mathematical hardware and be complete, but rather to draw attention to various assumptions and approximations. It is not the illusion given, that diffraction belongs to the "classical" solved problems. Author

N65-33508# Pennsylvania State Univ., University Park. Dept. of Meteorology.
MEASUREMENTS OF THE RADAR CROSS SECTIONS FOR SMALL BALLOON TARGETS
Larry G. Davis 30 Apr. 1965 6 p
(TN-9)

Measurements of the X-band radar cross sections for a variety of small balloon targets are summarized. A general discussion of small radar targets, including the characteristics considered in selecting corner reflectors, is presented. Procedures for calibrating radars and methods of obtaining radar cross sections of targets are outlined. Tabulated data for each type of target are presented and include target description and dimensions, theoretical and measured radar cross section, and fluctuations. R.N.A.

N65-33512# Electro-Voice, Inc., Buchanan, Mich. Engineering Dept.
[DESIGN OF HEADBANDS, EARPHONES, AND MICROPHONES] Research Contract Status Report, 15 Dec. 1964–15 Jan. 1965
Robert C. Ramsey [1965] 6 p
(Contract AF 33(615)-1295)
(AD-462864)

Considerations of magnetic and electric field interference pickup determined that the best protection against interference from electric and magnetic audio frequency fields would result from the use of a 150 ohm microphone impedance feeding a shielded twisted pair. Also, the placement of a transistor amplifier at or near the microphone would eliminate the need for using a shielded cable and would provide greater protection against possible pickup of interference in the cable. An experimental headband using adjustable clamping pressure was constructed. This headband is shown. Further, the construction of three experimental microphones were initiated. The fabrication of external cases with insert molded lead and support wires was completed. E.E.B.

N65-33544*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
A DEMODULATION SYSTEM FOR VECTOR MEASUREMENTS FROM A SPINNING SATELLITE
William J. Kerwin and Robert Munõz Washington, NASA, Sep. 1965 14 p
(NASA-TN-D-2310) CFSTI: HC $1.00/MF $0.50 CSCL 17B

A two-phase demodulation technique is described which recovers the original signal information from a modulated carrier irrespective of the relation between carrier and signal frequencies. An application is made to the design of a system for processing information from sensors on a spinning satellite. The system recovers the vector components of the data independent of the rotation of the satellite. This system allows direct interpretation of data frequencies below, at, and above the spin frequency. Author

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N65-32417* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

NUMERICAL INTEGRATION OVER A FAMILY OF ELLIPSES USING A SECOND-SUM MULTI-STEP INTEGRATOR EMPLOYING HIGH-ORDER BACKWARD DIFFERENCES

C. J. Devine *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 33–37 ref (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

The accuracy studies of second-sum Adams-type predictor–corrector numerical integrator was continued employing high-order backward differences. A description of the second-order differential equations to be solved is given along with the analytical solution of the differential equations from which the true solution was computed for a check of the errors made in the numerical solution. Also, the detailed derivation of the integration formulas and the method of computing a starting table are presented. The coefficients employed were computed by a 7094 computer program using 140-bit arithmetic. This program will compute coefficients to any order desired. The main results of the integration over a family of ellipses determined by the eccentricity for values of 0.1, 0.2,... 0.9 are described. For small eccentricity, less or equal to 0.2, the eccentricity associated with most of the planets, the results are almost exactly the same as for those done over the unit circle. For large eccentricity, equal or greater than 0.25, a smaller step size is required to obtain the same accuracy. E.E.B.

N65-32466* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

ONTO FINITE STATE MACHINES

E. C. Posner *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 273–274 ref (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

Onto finite state machines are considered. Machines that have every output sequence arise from some input sequence are in such a category and it is shown that if every output sequence arises from at most a bounded number of input sequences, then the machine is onto. E.E.B.

N65-32468* Jet Propulsion Lab., Calif. Inst., of Tech., Pasadena.

WEIGHTS OF CYCLIC CODES

G. Solomon *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 278–281 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

A new formula is presented for the weight or number of ones in a binary cyclic code. The formula allows quick computation of the error-correcting properties of a large class of codes. Author

N65-32469* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

THE INDEX OF COMMA FREEDOM IN KRONECKER PRODUCT CODE DICTIONARIES

J. J. Stiffler *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 281–286 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

This article relates the comma-free properties of the Kronecker product of two linear codes to the comma-free properties of the constituent codes. These relations are useful in quickly producing codes with special comma-free properties. Author

N65-32472* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

PROBABILITIES OF OVERFLOW AND ERROR IN CODED PHASE-SHIFT-KEYED SYSTEMS WITH SEQUENTIAL DECODING

I. Jacobs *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 296–299 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

A coded binary phase-shift-keyed system, in which sequential decoding is normally performed in real time but occasionally off-line, is considered for use over an additive Gaussian noise channel. Both the probability of an undecodable block and the probability of undetected error in a decoded block are determined to be less than 10^{-5} when the energy utilized per bit is 3.8 db above the minimum set by the infinite-bandwidth channel capacity. After accounting for a 0.5 db degradation to permit word and decoder synchronization, an advantage remains over a system using biorthogonal signaling (but no further coding) of 4.3 db for 32 biorthogonal signals and 2.3 db for 1024 biorthogonal signals. (In both biorthogonal cases, optimum receivers are assumed with a word error probability of 10^{-5}.) Thus, this system has signal-to-noise advantages over biorthogonal telemetry. Author

N65-32473* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

SEQUENTIAL DECODING WITH BIORTHOGONAL ALPHABET AND LIST DECODING

I. Jacobs *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 299–303 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

M-ary biorthogonal modulation and list decoding is considered for use with convolutional encoding and sequential decoding on a coherent additive Gaussian noise channel. Performance is found to be degraded from that achieved with binary phase-shift-keyed modulation and 3-bit quantized detection. Author

N65-32547*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

TELEMETRY COMPUTER INTEGRATION SYSTEM

Donald E. Jamison Jul. 1965 39 p (NASA-TM-X-55279; X-545-65-283) CFSTI: HC $2.00/MF $0.50 CSCL 09B

The design concept involved in this project considers the feasibility of integrating a high speed, general purpose, small scale, digital computer with a pulse frequency modulation signal reduction and conversion system to obtain the highest quality of intelligence in a minimum period of time. Author

N65-32550# Joint Publications Research Service, Washington, D. C.

PROBLEMS IN CYBERNETICS

A. A. Lyapunov, ed. 16 Aug. 1965 335 p refs Transl. into ENGLISH of the book "Problemy Kibernetiki" Moscow, Nauka Publishing House, 1965 p 1–252
(JPRS-31569; TT-65-32065) CFSTI: $7.00

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8. "ONE SUIT" (PROGRAMMING OF A GAME PROBLEM) A. L. Brudno and I. Ya. Landau p 191–217 refs (See N65-32558 21-08)

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10. ON THE EXISTENCE OF FEEDBACK WHICH CONTROLS THE SEX RATIO V. A. Geodakyan p 252–261 refs (See N65-32560 21-04)
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17. HEREDITARY INFORMATION AND ITS TRANSFORMATIONS I. I. Shaml'gauzen p 331–332

N65-32554 Joint Publications Research Service, Washington, D. C.

REALIZATION OF FUNCTIONS OF THE ALGEBRA OF LOGIC BY AUTOMATA, NORMAL ALGORITHMS AND TURING MACHINES

V. A. Kuz'min *In its* Probl. in Cybernetics 16 Aug. 1965 p 97–128 refs (See N65-32550 21-08) CFSTI: $7.00

The algebra of logic is investigated for functions of n variables belonging to three classes of control systems. All of these systems read and inform in a two-letter alphabet, but the normal algorithms and Turing machines can for internal purposes during calculation of values for the functions use an alphabet of greater multiplicity. Automata, normal algorithms, Turing machines, and the realization of systems of functions of the algebra of logic are discussed. E.E.B.

N65-32555 Joint Publications Research Service, Washington, D. C.

ON SOME CLASSES OF LOGICAL FUNCTIONS RELATED TO THRESHOLD FUNCTIONS

L. A. Sholomov *In its* Probl. in Cybernetics 16 Aug. 1965 p 129–156 refs (See N65-32550 21-08) CFSTI: $7.00

The method of recognition of functions is investigated by means of reduction to certain standard functions of a fewer number of variables. For this purpose the system $\{ I \}$ of allowable operations is introduced and the classes of functions are investigated which are closed with respect to the operations of the system. Such in particular are the classes of totally congruent functions in threshold functions. Each such class is characterized by the system $[f_1, f_2, \ldots, f_n]$ of standard functions having the property that any function $f \varepsilon \eta$ is reduced at least to one of f_i allowable operations. It is shown that the class of fully congruent functions has a unique generating element. This fact is used for recognition of fully congruent functions. Expressions are studied between the classes of homogeneous, fully congruent, and threshold functions. The threshold functions have the property of being k-acyclic and fully acyclic. Some results for a system of k-acyclic functions are formulated. E.E.B.

N65-32556 Joint Publications Research Service, Washington, D. C.

ASYMPTOTES OF OPTIMAL PROBABILITY OF ERROR FOR TRANSMISSION OF INFORMATION ALONG A CONTINUOUS SYMMETRICAL CHANNEL WITHOUT MEMORY WITH CANCELLATION

M. Ye. Ratner *In its* Probl. in Cybernetics 16 Aug. 1965 p 157–177 refs (See N65-32550 21-08) CFSTI: $7.00

The concepts of a symmetrical channel without memory with a finite number of symbols at the input and output are presented. The asymptote of optimal error probability obtained in this analysis for those channels is similar to that found by Dobruskin for the optimal error probability in discrete channels described by a symmetrical matrix of transition probabilities. E.E.B.

N65-32558 Joint Publications Research Service, Washington, D. C.

"ONE-SUIT" (PROGRAMMING OF A GAME PROBLEM)

A. L. Brudno and I. Ya. Landau *In its* Probl. in Cybernetics 16 Aug. 1965 p 191–217 refs (See N65-32550 21-08) CFSTI: $7.00

A computer program is described for a one suit card game similar to two-handed preference. Various situations are discussed for such a game programmed between man and machine and the reaction of the program to various actions of the man are considered. E.E.B.

N65-32562 Joint Publications Research Service, Washington, D. C.

ALGORITHMS REALIZED BY REPEATED APPLICATIONS OF FINITE AUTOMATA

Yu. V. Glebskiy, A. M. Dudich, D. I. Kogan, M. I. Liogon'kiy, and Al. A. Markov *In its* Probl. in Cybernetics 16 Aug. 1965 p 321–324 refs (See N65-32550 21-08) CFSTI: $7.00

The investigation of algorithms is defined in the following manner. Given a finite automaton, pass through it a tape with a word written on it; the tape obtained as the result is again passed through the automaton, and the procedure is continued to the point where the stop signal is received. If in doing this only synchronous finite automata are taken and it is considered that the given automaton represents a set of those words for which the automaton stops, then the class of all sets represented by the automata in this way is wider than the class of sets represented by the automata in the ordinary sense but narrower than the class of all sets which respond to algorithmically resolved predicates. If the generalized finite automata are taken, then repeating the use of these automata permits obtaining any algorithm. Other problems are investigated related to repeated use of finite automata. E.E.B.

N65-32575# Joint Publications Research Service, Washington, D. C.

PROBLEMS IN INFORMATION TRANSMISSION

16 Aug. 1965 96 p refs Transl. into ENGLISH of 9 Articles from Probl. Peredachi Inform. (Moscow), v. 1, no. 1, 1965 p 3–25, 52–87, 105–112, 122–124 (JPRS-31557; TT-65-32053) CFSTI: $3.00

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7. PROCEDURE FOR FINDING OPTIMAL INFORMATION TRANSMISSION PATHS A. V. Butrimenko and V. G. Lazarev p 69–78 refs (See N65-32582 21-08)

8. THE ROLE OF THE SEXES IN TRANSMISSION AND CONVERSION OF GENETIC INFORMATION V. A. Geodskyan p 79–88 refs (See N65-32583 21-04)

9. IDEAL PHYSICAL CHANNEL OF INFORMATION TRANSMISSION L. B. Levitin p 89–93 refs (See N65-32584 21-33)

N65-32576 Joint Publications Research Service, Washington, D. C.

"QUANTITY OF INFORMATION" DEFINED

A. N. Kolmogorov *In its* Probl. in Inform. Transmission 16 Aug. 1965 p 1–11 refs (See N65-32575 21-08) CFSTI: $3.00

Two approaches are known to the definition of the concept "quantity of information": the combinatory approach and the probability approach. The essence of these approaches is described in brief. A new, algorithmic approach which uses the theory of recursive functions is introduced. Author

N65-32577 Joint Publications Research Service, Washington, D. C.

BINARY CODES WITH CORRECTION OF DROPPING AND INSERTION OF THE SYMBOL 1

V. I. Levenshteyn *In its* Probl. in Inform. Transmission 16 Aug. 1965 p 12–32 refs (See N65-32575 21-08) CFSTI: $3.00

In the present article the binary codes of length n with correction of dropping and insertion of the symbol 1 are investigated with respect to the same diagram as the binary codes with correction for dropping and insertion of arbitrary symbols (0 and 1) investigated in the work. A procedure is presented for construction of asymptotically optimal (when $n \to \infty$) codes with correction of dropping or insertion of the symbol 1, and also the procedure for construction of codes with asymptotically minimal redundancy which permit correction of s or fewer drops and insertions of the symbol 1. Also, optimal selection is carried out for a separation word which permits realization of automatic decoding of output of a channel in which in each interval of length n no more than s drops and insertions of the symbol 1 takes place. Author

N65-32578 Joint Publications Research Service, Washington, D. C.

REACTION OF A SINGLE CYCLE DISCRETE AUTOMATON TO VARIATION OF INPUT EFFECT

V. N. Roginskiy *In its* Probl. in Inform. Transmission 16 Aug. 1965 p 33–39 refs (See N65-32575 21-08) CFSTI: $3.00

The behavior during transition periods of single cycle discrete automata (relay devices) which have delay are investigated. Concepts of transition functions are introduced for these automata and output reactions to variations in input signals. A procedure is offered for finding reactions both for unique input variations and for given series of variations. For calculation of reactions a special fixed-valued calculus is used. Author

N65-32579 Joint Publications Research Service, Washington, D. C.

SOME PROPERTIES OF SYMMETRICAL FUNCTIONS OF THREE-VALUED LOGIC

B. L. Ovsiyevich *In its* Probl. in Inform. Transmission 16 Aug. 1965 p 40–49 refs (See N65-32575 21-08) CFSTI: $3.00

Some properties of symmetrical functions of three-valued logic are discussed, the class of so-called circular functions. Procedures are proposed for detecting symmetry and circularity of functions and also procedures for synthesis of systems which realize symmetrical and circular functions on a majority basis. Author

N65-32580 Joint Publications Research Service, Washington, D. C.

BEHAVIOR OF AUTOMATA IN PERIODIC RANDOM MEDIA AND THE PROBLEM OF SYNCHRONIZATION IN THE PRESENCE OF NOISE

V. I. Varshavskiy, M. V. Meleshina, and M. L. Tsetlin *In its* Probl. in Inform. Transmission 16 Aug. 1965 p 50–58 refs (See N65-32575 21-08) CFSTI: $3.00

In this work the behavior of automata in random (environment) is investigated for automata, the probability

characteristics of which are periodically switched. Constructions of the automata which minimize the mathematical expectancy of a penalty for the case of a known switching period and for the case where the switching period is determined by the automaton, are described. The possibility of description of the synchronization process is investigated, for example, in the system of transmission of telemetric information with time division of channels in the presence of noise in terms of behavior in the periodic random media. The possibility is pointed out of using for construction of corresponding synchronizers the principles of construction of the automata investigated in this article. Author

N65-32581 Joint Publications Research Service, Washington, D. C.
USING TEXT ORDERLINESS TO EXTEND THE POSSIBILITIES OF READING DEVICES
V. S. Fayn *In its* Probl. in Inform. Transmission 16 Aug. 1965 p 59–68 (See N65-32575 21-08) CFSTI: $3.00

The problem of existence and ways of using orderliness inherent in meaningful text in contrast to individual letters in reading devices is discussed. The possibility is established of increasing the reliability of recognition and symmetrically decreasing the set of standards for reading of a large number of different scripts by using the indicated orderliness. Author

N65-32582 Joint Publications Research Service, Washington, D. C.
PROCEDURE FOR FINDING OPTIMAL INFORMATION TRANSMISSION PATHS
A. V. Butrimenko and V. G. Lazarev *In its* Probl. in Inform. Transmission 16 Aug. 1965 p 69–78 refs (See N65-32575 21-08) CFSTI: $3.00

In this work a method for decentralized control of a communication network is proposed and discussed. During operation of the network, optimal information transmission paths are formed. The method permits high vitality in the network. A variation of technical realization of this procedure is also discussed in the article for use of existing apparatus. Author

N65-32588# Chicago Univ., Ill. Inst. for Computer Research.
ICR QUARTERLY REPORT, NO. 5
Richard H. Miller et al 1 May 1965 201 p refs
(Contract AT(11-1)-614)
(COO-614-34)

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2. AUTOMATIC RETRIEVAL SPARK CHAMBERS J. Bounin, R. H. Miller, and M. J. Neumann 83 p refs (See N65-32589 21-24)
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8. AN ALGEBRA FOR (m,p) SWITCHING NETS E. V. Krishnamurthy 6 p refs (See N65-32593 21-08)

N65-32590 Chicago Univ., Ill. Inst. for Computer Research.
EXPERIMENTAL INVESTIGATION OF UNNORMALIZED ARITHMETIC
R. L. Ashenhurst *In its* ICR Quart. Rept., No. 5 1 May 1965 51 p refs Presented at the Symp. on Error in Digital Computation, Wis. Univ., 26–28 Apr. 1965 (See N65-32588 21-08)

Numerical experiments were carried out on the Maniac III computer to evaluate the efficacy of unnormalized floating-point calculations, performed in conjunction with appropriate adjustments for certain situations. It was found that careful use of unnormalized arithmetic can yield dividends in error monitoring, without undue sacrifice in accuracy. Error monitoring features can be incorporated into standard subroutines without a great degree of procedural details. G.G.

N65-32592 Chicago Univ., Ill. Inst. for Computer Research.
A DUALITY THEOREM IN COMBINATIONAL SWITCHING
E. V. Krishnamurthy and E. Bodfish *In its* ICR Quart. Rept., No. 5 1 May 1965 6 p refs (See N65-32588 21-08)

Presented is a duality theorem in combinatorial switching between AND-OR logic. Assumed was that if the operation S (a summation operation in the OR sense) or P (a product operation in the AND sense) is carried out singly or in sequence, the first or inner operator operates within a particular combination, while the second or outer operator operates among the different combinations. Used was a combinatorial set composed of the distinct combinations of p elements taken from a finite set of m distinct switching elements, where $m \geq p \geq 1$. G.G.

N65-32593 Chicago Univ., Ill. Inst. for Computer Research.
AN ALGEBRA FOR (m,p) SWITCHING NETS
E. V. Krishnamurthy *In its* ICR Quart. Rept., No. 5 1 May 1965 6 p refs (See N65-32588 21-08)

An (m,p) switching network is defined as an m-component-switching network that results in a closed state when at least p of its components are in a closed state. Some of the basic properties of these networks are outlined, and it is shown that this logic (algebra) is isomorphic to the many-valued logic of Post, and can be used in designing error-free logic systems. Only a two-valued operation of the switch system was considered, viz. I or O. G.G.

N65-32642# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMPUTER MATHEMATICS AND ENGINEERING Selected Articles
12 Jul 1965 28 p refs Transl. into ENGLISH from "Obchyslyuval'na Matematyka i Tekhnika" Kiev, Akad. Nauk Ukr. SSR, 1963 p 90–99, 113–117
(FTD-TT-65-347/1+2+4; AD-467266)

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1. ABOUT A METHOD OF ANALYZING THE RELIABILITY OF FUNCTIONAL SYSTEMS OF DIGITAL COMPUTERS S. S. Zabara p 1–16 refs (See N65-32643 21-08)
2. ABOUT ONE VARIANT OF AN INFORMATION DEVICE WITH THE USE OF A FERRITE MEMORY UNIT I. G. Moroz p 17–25 refs (See N65-32644 21-08)

N65-32643 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ABOUT A METHOD OF ANALYZING THE RELIABILITY OF FUNCTIONAL SYSTEMS OF DIGITAL COMPUTERS
S. S. Zabara *In its* Computer Math. and Eng. 12 Jul. 1965 p 1–16 refs (See N65-32642 21-08)

An analysis of the reliability of functional systems of digital computers is made on the basis of known characteristics of elements. The structural reliability of memory elements, signals, and micro-operations inside the machine is discussed. The effect of a complex of outer perturbation factors on the reliability is included. It is concluded that structural reliability should be a major criterion considered when synthesizing and comparing various functional systems. C.T.C.

N65-32644 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ABOUT ONE VARIANT OF AN INFORMATION DEVICE WITH THE USE OF A FERRITE MEMORY UNIT
I. G. Moroz *In its* Computer Math. and Eng. 12 Jul. 1965 p 17–25 ref (See N65-32642 21-08)

A method of organizing a ferrite memory unit for use in an information device is given. The method is described in detail and has greatest application where a comparatively large number of input data is introduced and a rapid reply is necessary. It is concluded that the ferrite arrangement is on the average 50 to 100 times faster than a magnetic drum. C.T.C.

N65-32713# Massachusetts Inst. of Tech., Cambridge.
A NEW METHODOLOGY FOR COMPUTER SIMULATION
Martin Greenberger [1964] 30 p refs Presented at the Conf. on Computer Methods in the Analysis of Large-Scale Social Systems, Cambridge, Mass., 19–21 Oct. 1964
(Contract Nonr-4102(01); Proj. Mac.)
(MAC-TR-13; AD-609288)

Computer simulation is a cooperative venture between researcher and information processor, but the processor's role customarily begins too late. The researcher can benefit substantially by bringing the computer up into the earlier, creative phases of the simulation process. An on-line computer system that makes this possible is described. Author

N65-32743# Martin Co., Baltimore, Md. Electronic Systems and Products Div.
RESEARCH FOR HIGH SPEED ANALOG-TO-DIGITAL CONVERSION TECHNIQUES Technical Documentary Report, 15 Jun. 1963–15 May 1964
Brian E. Sear Wright-Patterson AFB, Ohio, Avionics Lab., Aug. 1964 212 p refs
(Contract AF 33(657)-11370)
(AFAL-TDR-64-154; AD-604421)

A generalized diode model is developed and simulated on an analog computer. Comparisons are given between computer solutions and experimental results. Transient response solutions of picosecond pulse generator circuits are obtained on the computer by using the diode model for all diodes in the network. A triplate tester design is given with experimental results from a sampling oscilloscope which show good correlation with the analytical results. Two one-gigabit shift register circuit arrangements are synthesized on the computer and solutions for network variables given. A triplate tester design is discussed and test results showing good operational margins at a one-gigabit rate are given. All noise contributors to the system accuracy are considered and calculations made of quantization and dynamic range sensitivities. An analysis, made by calculating the charge required to switch, is presented for the tunnel diode switching response to a sampling pulse that is perturbed by noise. A feedback loop reference circuit is proposed to overcome the absolute drift in threshold level. The diode model is used to synthesize all diodes in the tunnel diode charge transformer NOR/OR logic on the analog computer. R.N.A.

N65-32747# David Taylor Model Basin, Washington, D. C. Acoustics and Vibration Lab.
MECHANIZED COMPUTATION OF SHIP PARAMETERS
Ralph C. Leibowitz and Robert L. Harder Jun. 1965 92 p refs
(DTMB-1841; AD-618734)

For the purpose of vibration and load analysis a ship hull is often regarded as a flexural beam. This report describes a method and numerical computer (digital) program to calculate ship section properties (i.e., equivalent beam parameters) needed for the beam vibration equations and its internal shear distribution, using data tabulations obtained from hull plans by a pre-established orderly procedure. The program has been written in FORTRAN and can be used on an IBM 650, 704, 709, or 7090. Comparison between digital computer and hand calculations for a sample problem shows excellent agreement. Author

N65-32755*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
SEQUENTIAL MEASUREMENT OF MULTIDIMENSIONAL TRANSDUCERS Technical Report No. 431
J. R. Sklar 29 Oct. 1964 88 p refs
(Grants NsG-334; NsG-496; NIH G-MH-04737-04; NSF GP-2495; Contract DA-36-039-AMC-03200(E) et al)
(NASA-CR-64467) CFSTI: HC $3.00/MF $0.75 CSCL 09B

An analysis of the application of a sequential decoding algorithm to measurement problems has resulted in bounds to the average number of computations required to estimate one parameter. A bound is also derived for the probability of incorrectly estimating at least one parameter of a set. The precision obtained with the sequential method is limited when an attempt is made to differentiate between parameter values that produce too small an effect on the output relative to noise. This critical level or limit may be compared to the computational cutoff rate in the corresponding communication problem. Characteristic impedance values of the sections of a transmission line constructed of many short segments were estimated, and this problem can be likened to geophysical layer determination. Although the theoretical and simulated measurement problems are not identical, the theoretical and experimental results agree quantitatively. It is, therefore, considered that further research is warranted on the application of sequential decoding to actual measurement problems. M.W.R.

N65-32771# United States Industries, Inc., Silver Spring, Md.
A GUIDE TO PREPARING INTRINSICALLY PROGRAMMED INSTRUCTIONAL MATERIALS
R. E. Walther and Norman Crowder Wright-Patterson AFB, Ohio, AMRL, Apr. 1965 105 p
(Contract AF 33(616)-6983)
(AMRL-TR-65-43; AD-617740)

A guide designed to aid in the preparation of intrinsically programmed instructional materials for use in auto-instructional systems, is reported. Instructions, suggestions, and techniques described apply only to the system known as intrinsic programming; and are intended to guide inexperienced program producers through the initial phases of their programming efforts with a minimum number of false starts. Organization of the material follows closely the sequential order by which the program must develop. Presented are data in the following sequence: logistics of programming (planning); reporting progress and records; selecting personnel for programming; program development cycle; establishing training objectives, content, and sequence; programming technology; page format and manuscript assembly; preliminary editorial reviews; scrambling the manuscript; pre-production evaluation; production of final copy; and program validation. S.C.W.

N65-32848# System Development Corp., Santa Monica, Calif.
APPLICATION OF EMPIRICAL METHODS TO COMPUTER-BASED SYSTEM DESIGN
Gloria Lauer Grace 1 Jun. 1965 29 p refs Presented at the 45th Ann. Meeting of the Western Psychological Assoc., Honolulu, Hawaii, 14–19 Jun. 1965
(SP-1952; AD-617772)

Because computer systems currently tend to be user-orientated, a comparative study of verbal, data block, and eidoform printout format usage ease was undertaken. The measure of printout effectiveness was the subject score on interpretation questioning. For three trials verbal and data block were about equally effective, while eidoform printouts tended to be less effective and harder to understand. The feasibility of applying empirical methods to computer printout design was demonstrated by this study. W.M.R.

N65-32911# Sandia Corp., Albuquerque, N. Mex.
THE DESIGN AND ANALYSIS OF ELECTRONIC CIRCUITS BY DIGITAL COMPUTERS
J. L. Wirth Oct. 1964 15 p refs
(Contract AT(29-1)-789)
(SC-R-64-1355; CONF-776-1)

The role of the digital computer in the design and analysis of electronic circuits is discussed with special attention given to the problems created by steady-state and transient nuclear environments. Examples are presented which illustrate the usage, capability and limitations of several existing analysis programs. The current direction of research and programming efforts in the area of automatic circuit analysis programs is also considered. Author

N65-32929# Dunlap and Associates, Inc., Darien, Conn.
MAN–COMPUTER INTERACTIONS IN IDEALIZED TACTICAL PROBLEM SOLVING Final Report
U. O. Gagliardi, R. A. Hussey, I. T. Kaplan, and R. J. Matteis May 1965 88 p refs
(Contract Nonr-3602(00))
(AD-618707)

In developing an operating system to allow experimentation with dynamic tasks, automated problem solving aids were tested. These had a broad range of application and included subject command results. The aided system delegated the subtask of finding key elements to an automated process, and allowed the person to assemble the elements into deployments. A simple example of submarine targeting optimization is included. W.M.R.

N65-32961*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A CENTRAL FACILITY FOR RECORDING AND PROCESSING TRANSIENT-TYPE DATA
Richard L. Smith et al Washington, NASA, Jan. 1963 82 p
(NASA-TN-D-1320) CFSTI: HC $3.00/MF $0.75 CSCL 09B

The data system described has the capability of recording and automatically processing transient-type data in the frequency range of 0 to 10,000 cps. Data are recorded in both analog and digital form on magnetic tape and are processed by either an analog or a digital computer. Special shielded cable is used to transmit the data at low voltage levels from six test facilities over cable lengths up to 7000 feet. Identification and search features are provided as well as a quick-look feature using a storage-type oscilloscope. The system has been in operation since March 1960. Author

N65-33002# Bettis Atomic Power Lab., Pittsburgh, Pa.
MO564, A FORTRAN PROGRAM FOR SYMMETRIC AND ASYMMETRIC RESONANCE INTEGRALS
D. R. Harris and G. J. Peters Nov. 1964 10 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-494) CFSTI: $1.00

A description is given of the FORTRAN program, MO564, designed for use on the Philco-2000 computer. The program computes the infinite dilution resonance integral, and the sum for a group of resonances, when the cross section for each resonance is represented by a single level Breit-Wigner formula. The calculation is carried out in two approximations referred to as symmetric and asymmetric corresponding to non-inclusion or inclusion of a lower energy cutoff and the $E^{-1/2}$ factor in the single level formula. The ratio of asymmetric to symmetric resonance integrals is plotted for practical ranges of resonance parameters and energy cutoff. Author

N65-33035# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
ANALOGUE COMPUTER USING FOURIER SERIES FOR OPTICAL SPECTROMETRY [CALCULATEUR ANALOGIQUE PAR SERIE DE FOURIER POUR SPECTROMETRIE OPTIQUE]
Paul Jouy and Jean-Francois Mougel Aug. 1964 39 p refs In FRENCH; ENGLISH summary
(CEA-R-2546) CFSTI: HC $2.00/MF $0.50

The object of the present report is to describe an electronic unit designed for the automatic calculation of optical spectra, a calculation carried out by a Fourier transformation of an interferogram recorded on magnetic tape. With this apparatus it is possible to calculate 20 points simultaneously and its theoretical resolving power is only limited by the duration of the interferogram. The practical limit due to the technique adopted is 5×10^6. Its general characteristics are the following: signal analysis for frequencies of between 3 and 10 Kc/s, no automatic progression of the analysis frequency 0.01 c/s, simultaneous calculation of 5 spectra and of 4 circuits per spectrum, compensation for the changes in the unrolling speed of the spectrum magnetic band, and choice of the origin frequency with an accuracy of 0.01 c/s. This description is preceded by a description of the spectrometric method using a Fourier transformation. Author

N65-33074# Measurement Analysis Corp., Los Angeles, Calif.
ENGINEERING APPLICATIONS OF ADVANCED TECHNIQUES OF RANDOM PROCESS ANALYSIS
J. S. Bendat and A. G. Piersol [1965] 101 p Summary of lectures presented at symp. held at Univ. of Southampton, 5–9 Jul. 1965 CSCL 09D

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N65-33142*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A SUMMARY OF METHODS FOR ANALYZING NONSTATIONARY DATA
J. S. Bendat and G. P. Thrall 1 Sep. 1965 16 p refs
(Contract NAS7-100)
(NASA-CR-64624; JPL-TR-32-744) CFSTI: HC $1.00/MF $0.50 CSCL 09B

This report summarizes theoretical ideas and techniques used for the analysis of nonstationary data. Details are presented for estimation of nonstationary mean values, correlation functions, and spectral density functions. Three methods are discussed for estimating nonstationary mean values: ensemble averaging, short-time averaging, and orthogonal-function averaging. Three methods are discussed for estimating nonstationary spectral density functions: double-frequency spectra, time-varying power spectra, and time-averaged power spectra. Author

N65-33194*# Case Inst. of Tech., Cleveland, Ohio. Digital Systems Lab.
A DIGITAL CONTROLLER USING MULTIRATE SAMPLING FOR GAIN CONTROL
Richard W. Van Pelt and Harry W. Mergler 1965 140 p refs
(Grant NsG-36-60)
(NASA-CR-64785; EDC-1-64-29) CFSTI: HC $4.00/MF $1.00 CSCL 09B

The conventional continuous proportional plus integral control algorithm is converted to its sampled, incremental form, then approximated by a set of three differences which are computed digitally and applied to the process actuator at different times and rates. Computation of the three terms at different rates serves to reduce the amount of equipment needed to provide a wide range of integral gain while retaining the stabilizing effect provided by frequent sampling of the proportional term. Tests demonstrate that the controller performs well for all types of industrial processes except flow loops with slow actuators. For this exception the controller can easily be modified to provide good response. The controller is designed to control a single loop either independently or in conjunction with a higher level control computer. Author

N65-33243# California Univ., Los Angeles. Dept. of Engineering.
NOTS-UCLA TRACKING INSTALLATION ANALOG TAPE DESCRIPTION AND REDUCING PROGRAM
Stanley Sokolow, David R. Garfinkle, Hilde Groth, and John Lyman Nov. 1964 69 p */ts* Biotechnol. Lab. Tech. Note No. 29
(Contract N123(60530)-32857A)
(Rept.-64-54; AD-461651)

The analog tape data recorded by the Sampled Error Scoring System is described; a program for reducing the data by means of the IBM 7090/7094 computer system is also described. Output data may be in the form of time-on-target charts and graphs or lists of pertinent variables. A sample execution and the Fortran II program are included as appendices. Author

N65-33294# Chicago Univ., Ill. Inst. for Computer Research.
[MANIAC III ENGINEERING ACTIVITY IN COMPUTER DESIGN AND INFORMATION SYSTEMS ENGINEERING] Quarterly Report No. 3
R. H. Miller and Nicholas C. Metropolis 1 Nov. 1964 97 p refs
(Contract AT(11-1)-614)
(COO-614-23)

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12. ON TWO VARIANTS OF A METHOD FOR THE SOLUTION OF LINEAR EQUATIONS WITH UNBOUNDED OPERATORS AND THEIR APPLICATIONS W. V. Petryshyn 6 p refs
13. COMMENTS ON THE ASTRONOMY MEETINGS R. H. Miller 7 p
14. REMARKS ON ISOPHOTOMETRY OF GALAXY PHOTOGRAPHS R. H. Miller 3 p
15. IRREVERSIBILITY AND CO-OPERATIVE PHENOMENA IN SMALL STELLAR DYNAMICAL SYSTEMS R. H. Miller 4 p
16. REMARKS ON A DISTRIBUTION FUNCTION ARISING IN ASTRONOMY R. H. Miller 5 p refs
17. DISTRIBUTED LAG DEMAND FUNCTIONS R. L. Graves and L. G. Telser 9 p ref

N65-33329# Computer Usage Co., Inc., New York.
ORGANIZATION OF A LARGE-SCALE COMPUTER PROGRAM FOR SPACE AGE GEODESY
C. Sheffield and J. P. Morris Dahlgren, Va., Naval Weapons Lab., 16 Jul. 1965 25 p Presented at the 20th Natl. Conf. of the Assoc. for Computing Machinery, Cleveland, Aug. 1965
(Contract N178-8619)
(NWL-1990; AD-467987)

The GEO-STRETCH program is a large-scale scientific computation which fits observations of artificial earth satellites to produce a detailed picture of the earth's gravitational field and surface geometry. It is run on an IBM STRETCH computer with 48,000 64-bit words of core storage, 10 tape drives and a 2,000,000 word disk store. The large amounts of observational data available and the number of physical parameters to be determined have necessitated novel segmentation procedures for the optimum use of core storage, and required the development of a fully automatic library procedure. In addition, the large number of operating modes required in the practical use of the program has led to a unique blend of scientific programming, software interpretive programs and large-scale data processing, which tax the capacity of the STRETCH computer to its practical limit. This paper describes the problems encountered in the program and the devices used to surmount them. Author

N65-33373# Army Missile Command, Huntsville, Ala. Army Inertial Guidance and Control Lab.
DATA REDUCTION OF ULTRA-LINEAR VOLTAGE CONTROLLED OSCILLATOR (LANCE ROUND 2)

Louie R. Bowling, Jr. and Clarence Brown, Jr. Jun. 1965 12 p ref
(RG-TR-65-13; AD-468462)

The ultra-linear voltage-controlled oscillator (ULVCO) produces data accurate within 0.02 percent. The purpose of this test was to reproduce this data with an accuracy within 0.02 to 0.05 percent using the magnetic tape recordings of the actual ULVCO flight data. The primary problem was the noise level (0.1 percent) on the tape. With a noise level below 0.05 percent, the data could be reproduced within an accuracy of 0.05 percent. Ramp curves were plotted to reproduce the ULVCO ramp, but equipment was inadequate to determine the amount of resolution being obtained on these plots. A plot of the reduced data was made to determine the distribution of the reduced data in relation to a linear ramp. The distribution of points fell on both sides of this ramp. ULVCO data can be reproduced with an accuracy within 0.05 percent only if the noise level of the reproduced data is below 0.05 percent. The 0.1 percent noise level obtained is due to intermodulation in the FM/FM TM system. Author

N65-33524# RAND Corp., Santa Monica, Calif.
PROGRAMMING BY QUESTIONNAIRE
Allen S. Ginsberg, Harry M. Markowitz, and Paula M. Oldfather Apr. 1965 47 p
(Contract AF 49(638)-700; Proj. RAND)
(RM-4460-PR; AD-613976)

A questionnaire technique for reducing the cost and time required to produce computer programs within specified areas of application is described. The approach is to present the user with a set of possible options, expressed in an English lauguage questionnaire. By choosing from these options, the user specifies all the information necessary to construct his desired computer program. A "Generator" program, informed of the selected options, then constructs the desired program and specifies the data that the user must supply in order to execute the generated program. Included are data on the components of the Generator program and primary advantages of this method. The mechanics of the program generation process are discussed in terms of an illustrative Job Shop Simulator Program Generator (JSSPG).
S.C.W.

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N65-32426* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THERMIONICS RESEARCH
K. Shimada *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 68–74 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

The low-frequency oscillations in cylindrical, cesium diodes were investigated. The type of oscillation examined was limited to the plateau part of the volt-ampere curve in the pre-breakdown regime. Typical oscilloscope records are shown for the case of a low emitter temperature and for the case of a high emitter temperature. The cesium reservoir temperature was the same for both. In both cases the resistance in series with the diode was 5 ohms. The amplitude of the current oscillation increased as the circuit resistance was decreased, whereas the amplitude of the voltage oscillation across the diode decreased as the resistance was decreased. It was observed that the maxima of the oscillation in current became larger as the resistance was decreased, but the minima remained nearly unchanged. Oscillations in the plateau region of the volt-ampere curve were found to occur when the temperature combinations were such that nearly neutral emission occurred at the emitter surface. Results suggested a functional dependence between the period of oscillation and the pressure-distance product. E.E.B.

N65-32429* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PRINTED CONDUCTOR ASSEMBLY SUBSTITUTION FOR MARINER C UPPER RING HARNESS
E. R. Bunker, Jr. *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 84–90 (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

The printed conductor assembly substitution for the Mariner C upper ring harness is described and details of the assembly are illustrated. Although construction details are similar to those for Mariner R, additional features were included in the design. The fundamental problem in layout of the printed circuit ring harness was providing adequate isolation for sensitive low-level lines from adjacent noisy or high-voltage lines, such as the 2400-cps square wave circuits. This was accomplished in the present Mariner C upper ring harness by using two harnesses to separate the 2400-cps power sources from other circuits. It is shown that in about 95% of the circuits, the noise pickup is appreciably less with the printed conductor ring harness as compared to the same circuit using the conventional cable harness. In the remaining 5% of the circuits the induced noise is somewhat greater than in the conventional cable harness but still well below the specification limit. Tests have shown that the printed conductor ring harness in its present configuration is a flight-quality item. E.E.B.

N65-32461* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SOLID-STATE CIRCUITS
R. Brantner *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 253–254 (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

Insulated-gate field effect transistors were tested to determine their potential use as voltage-controlled resistors. A typical curve of dynamic channel resistance versus gate-to-channel voltage is shown. Threshold voltage fell between −3.0 and −3.5 V for all units and the dynamic resistance was varied from well over 10 megohms to about 300 ohms. Two units having about the same resistance versus voltage characteristics were used to construct a parallel-T filter, the schematic of which is shown. Using various values of capacitors in the filter, tuning ranges of more than 200 to 1 were observed and usable characteristics were obtained at frequencies as high as 5 Mc. The filter response at 50 and 500 kc normalized to the center frequencies is presented. E.E.B.

N65-32474* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
CAPACITOR STERILIZATION TEST PROGRAM
K. Stern *In its* Space Programs Sum. No. 37–33, Vol. IV 30 Jun. 1965 p 305–306 (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

The capacitor sterilization test program is summarized. The primary objective of the program is to establish a sterilization parts list that tabulates the electronic component parts capable of withstanding several 36-hour periods of nonoperational storage at 145° C without significant degradation. The

dielectrics most significantly affected by sterilization temperature cycling were the ceramic and solid tantalum types. The capacitance and dissipation factor of the ceramic capacitors increased as a result of sterilization. However, during the 8000-hour life test at rated voltage and temperature, the capacitance and dissipation factor decreased gradually and approximated the values observed before sterilization. The temporary increase in capacitance and dissipation factor resulting from sterilization is probably acceptable providing the circuit applications permit a maximum factor value of 2.5% at 1 kc. Also, as a result of sterilization the insulation resistance of certain test codes decreased by a factor of 10. After 100 hours of life testing at rated voltage and temperature values increased to those observed prior to sterilization. E.E.B.

N65-32694# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STANDARD OF PROGRESS
V. Kalmykov 25 Jun. 1965 8 p Transl. into ENGLISH from Izvestiya (Moscow), 22 May 1965 p 5
(FTD-TT-65-705/1+4; AD-617669)

Technical progress in radio electronics and its impact on the general economy and military endeavors are discussed in narrative form. Because radio electronics has penetrated many areas in culture, science, and technology, it is considered a powerful means of increasing labor output. M.W.R.

N65-32736# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVICE FOR COUPLING WAVEGUIDES
A. P. Matyukhin 7 Jul. 1965 4 p Transl. into ENGLISH from Soviet Patent No. 159206 (Appl. No. 738156/26-9, 14 Jul. 1961) 2 p
(FTD-TT-65-336/1+2+4; AD-618092)

Described is a coupling device that contains waveguides of zigzag shape which are provided with supports and are placed in a rigid framework. This arrangement assures the preservation of the parallel arrangement of the joined flanges and simplifies the overall composition of the coupler. G.G.

N65-32745# Radio Corp. of America, Camden, N. J.
MICROMODULES, TASKS 36 AND 39. MICROMODULE PROGRAM EXTENSION II. PRODUCTION ENGINEERING MEASURE Formal Engineering Report
Jan. 1965 307 p
(Contract DA-36-039-SC-75968)
(AD-611399)

The industrial sources for microelements were established under their respective microelement PEM tasks (Tasks 28 through 33). The micromodule sources were established under PEM Tasks 36 and 39. The objective of Task 36 was to provide a module assembly facility capable of a balanced production rate of 200 modules per eight-hour day, by proceeding through a process analysis phase, a facilitation phase and a fabrication phase of preproduction modules to establish the adequacy of the implemented facility. The objective of Task 39 was to demonstrate, through a pilot run phase, the capability of the facilities established during the preproduction phase. It was determined that these objectives would best be attained by establishing several sources, in addition to RCA, for micromodules. Such parallel efforts would take advantage of the required diverse talents available in a broader segment of the electronics industry and thus insure that the best methods and approaches could be explored and selected for the final module assembly processes; also, that the microelements could be used by different companies, using diverse assembly processes for micromodules. In addition, it would provide multiple sources for micromodules for military equipment. Author

N65-32753*# National Aeronautics and Space Administration, Washington, D. C.
A THEORY FOR PROBE MEASUREMENTS OF ELECTRICAL CONDUCTIVITY OF SEMICONDUCTOR FILMS [O TEORII ZONDOVYKH IZMERENIY ELEKTROPROVODIMOSTI POLUPROVODNIKOVYKH PLENOK]
V. L. Kon'kov and R. A. Rubtsova Jul. 1965 14 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Fiz. (Tomsk), no. 1, 1965 p 135–141
(NASA-TT-F-9494) CFSTI: HC $1.00/MF $0.50 CSCL 09A

Formulas are obtained in general form for determining the electrical conductivity of fine films as a result of four-probe measurements. Certain special cases which are most frequently encountered during the measurements are investigated. Author

N65-32827# Sandia Corp., Albuquerque, N. Mex. Sandia Lab.
THE EFFECT OF CONDENSATION RATE ON THE TEXTURAL PROPERTIES OF VACUUM DEPOSITED GERMANIUM FILMS ON HEATED AMORPHOUS SUBSTRATES
L. E. Terry and J. D. Williams Oct. 1964 16 p refs
(Contract AT(29-1)-789)
(SC-TM-64-1208)

An investigation has been conducted to determine the effect of condensation rate on the textural properties of germanium films which have been vacuum deposited on heated amorphous substrates. Ranges of condensation rates from 0.2 to 380Å/sec for various substrate temperatures in the range 25° to 725°C have been investigated as predicted in SC-TM-306-63 (14). The [110] textural characteristics produced at low substrate temperatures and low condensation rates can be extended through higher substrate temperatures if the condensation rate is increased. Author

N65-32855# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN CHARACTERISTICS CONCERNING THE EFFECT OF X- AND GAMMA-RAYS ON THE ELECTRICAL RESISTANCE OF CdS CRYSTALS
M. A. Talibi and A. G. Yusifov 2 Jul. 1965 11 p refs Transl. into ENGLISH from Izv. Akad. Nauk Azerb. SSR, Ser. Fiz.-Mat. i Tekhn. Nauk (Baku), no. 6, 1960 p 91–97
(FTD-TT-64-1162/1+2+4; AD-617673)

The use of cadmium sulfide as a sensing element for an ionizing radiation dosimeter is described, with CdS fabricated as a polycrystalline layer component in a selenium rectifying element. The effect of X-rays of varying wave composition and intensity, and of gamma rays on the electrical resistance of CdS monocrystals was investigated. The determination of sensitivity was a dark resistance change, dependent upon the intensity and wave composition of the effective shortwave radiation. Resistance was measured with a multirange line megometer, and the need for individual calibration of each sensing element was indicated. W.M.R.

N65-32882*# California Univ., Santa Barbara.
PHOTOELECTRON ENERGY DISTRIBUTIONS IN THE FAR ULTRAVIOLET Status Report, Jan.–Jun. 1965
William C. Walker and Lanny R. Hughey [1965] 41 p refs
(Grant NsG-91-60)
(NASA-CR-64709) CFSTI: HC $2.00/MF $0.50 CSCL 09A

Photoemission has recently been recognized as a useful technique for studying electronic properties of solids. The purpose of this work has been to develop the electronic and other experimental equipment needed to measure both the quantum yield and energy distributions of photoelectrons. The system which was developed permits the direct recording of energy distributions by measuring the a-c conductance of a photocell subjected to a retarding potential. The system was

tested by obtaining preliminary measurements of photoelectron energy distributions from electropolished indium for selected wavelengths between 500 A and 2000 A. The results indicate that accurate energy distributions can be measured for photocurrents as low as 10^{-11} amp. Since the electropolished indium was not atomically clean no detailed interpretation of the data was attempted. A previously unobserved peak at 7 eV in the energy distribution for 21.2 eV photons was found which does not correspond to any known maximum in the density of states. Author

N65-32904# CBS Labs., Stamford, Conn.
ALL-EVAPORATED AND MASKLESS FABRICATION TECHNIQUES FOR ACTIVE DEVICES Interim Development Report, Mar. 1–May 28, 1965
23 Jun. 1965 13 p refs
(Contract NObsr-87512)
(IDR-4; AD-465233)

The emphasis has been put on the ion implantation of silicon. The apparatus has been adjusted and some samples have been bombarded with indium ions. The evaluation of these samples has begun. In addition, two silicon evaporation runs have been made. Author

N65-32912# Sandia Corp., Albuquerque, N. Mex.
A COMPARISON OF RADIATION TOLERANCE OF FIELD EFFECT AND BIPOLAR TRANSISTORS
B. L. Gregory and F. M. Smits Oct. 1964 9 p refs
(Contract AT(29-1)-789)
(SC-R-64-1333)

An analytical comparison of the radiation tolerance of conventional silicon field effect transistor and of silcon bipolar transistor has been performed. The channel or bas thickness has been used as the respective critical variable, since it measures the degree of difficulty of device fabrication. For field effect transistors, the pinch-off voltage has been used as a free parameter. Based on recent lifetime degradation data for bipolar transistors and on carrier removal data for material of variable resistivity, it is shown that field effect transistors are not inherently more radiation tolerant than bipolar transistors. Only field effect transistors with pinch-off voltage well in excess of 10 volts appear superior to bipolar transistors. Author

N65-32946# International Business Machines Corp., Owego, N. Y. Space Guidance Center.
INTEGRATED VHF AMPLIFIER DEVELOPMENT Interim Report, 1 Nov. 1964–28 Feb. 1965
Mar. 1965 54 p
(Contract AF 33(615)-1984)
(IBM-65-928-31; AD-465028)

A final amplifier design approach based on thin-film technology was formulated for an integrated VHF amplifier. Some of the peculiarities of packaging thin-film VHF circuits were determined; and thin-film, and discrete components for use in thin-film circuits were characterized. A breadboard of the initial circuit design using discrete components was constructed, and tested. In addition, a four-stage 70-mc thin-film amplifier using a thin-film circuit panel and thick-film coil panel mounted back-to-back, was fabricated, tested, and operated successfully. Characterization tests of other thin-film and discrete components, and leakage paths through panels, are also reported. L.S.

N65-32958*# Tobe Deutschmann Labs., Canton, Mass.
EVALUATION OF CAPACITORS FOR SPACE PROPULSION APPLICATIONS Final Progress Report
E. Blank, J. Proud, and A. Winston [1965] 98 p
(Contract NAS3-2505)
(NASA-CR-54057; TD/SS1-FR-21) CFSTI: HC $3.00/MF $0.75 CSCL 10C

The development and evaluation of very low inductance energy storage capacitors, capable of long term performance at elevated temperature, is described. Based on general goals for capacitor characteristics in space propulsion applications, the central development problem is identified as the problem of attaining high temperature and high Q properties for materials employed in laminated capacitors. This need arises from the requirement to radiate self-generated heat while internal heating is reduced by employing low dissipation material. The report traces the development of fabrication techniques using a high temperature mica paper dielectric and describes the evaluation and testing of finished specimens. Dynamic testing is carried out at high repetition rates using a coaxial plasma gun as the electrical load, while the entire capacitor-gun system is operated in vacuum. Author

N65-33013# Pickard and Burns Electronics, Waltham, Mass.
ATOMIC OSCILLATOR DEVICE FOR NAVIGATION-GUIDANCE Interim Engineering Report No. 4
R. H. Woodward, L. Johnson, R. Sanborn, I. Felch, and R. L. Smith Wright-Patterson AFB, Ohio, ASD, 30 Oct. 1964 111 p refs *Its* Publ. No. 916
(Contract AF 33(657)-11384)
(ASD-TDR-64-4; AD-609776)

Detailed design parameters and usable hardware for the new cesium beam tubes were generated. Assembly of a prototype beam tube is the next step. Two breadboard primary loops were tested using comparison techniques. Results indicate that spectral purity requires further improvements, which will be a major task next interim. Author

N65-33017# Los Alamos Scientific Lab., N. Mex.
ELECTRICAL CHARACTERISTICS OF COAXIAL CABLE
G. P. Boicourt 31 Aug. 1965 15 p Sponsored by AEC
(P-16)

Measurements of inductance, resistance, and capacitance for several coaxial cables commonly used as transmission lines in energy storage capacitor banks were made to obtain data for use in the design and selection of cables of known electrical characteristics for controlled thermonuclear research experiments. Presented are measured values for braided- and solid center conductor-cables which were made in a ringing capacitor discharge circuit using a current range of 10000- to 50000-A, and a frequency range of 10 to 65 kc/sec. Included are data on the thickness of the interconductor insulation, and inherent errors associated with skin depth changes. S.C.W.

N65-33026# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
USE OF CHARGE STORAGE TUBE IN THE BUILDING OF A BUFFER MEMORY [APPLICATION DES TUBES A MEMOIRE A LA REALISATION D'UNE MEMOIRE TAMPON]
Claude Marcovici (Ph.D. Thesis—Grenoble Univ., France) 1964 96 p refs In FRENCH; ENGLISH summary
(CEA-R-2457) CFSTI: HC $3.00/MF $0.75

The apparatus manufactured is a buffer memory to be located between a detector and a multichannel pulse height analyzer which received the pulses at regular times. The buffer memory and the detector have the same order of dead time. The apparatus used two electrostatic barrier grid tubes; the first one stores temporarily the data from the detector during the

time necessary to analyze the data recorded on the other one. At the end of the analysis, the roles of the two tubes are permuted. The advantage on similar other apparatus is the uninterrupted recording of the pulse height informations from the detector and the uninterrupted analysis. In addition, the transistorization is interesting for reliability and maintainability. The document presents principles and data on the barrier grid storage tube, considers its conventional uses in nuclear electronics, and studies statistically the reduction of counting losses. It describes the test equipment and the tests which permits the screening of the best cathode ray storage tube for this application. Finally, it describes the item and gives the wave shapes in various points of the buffer memory. Author

N65-33043# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy)
A 200 MHz DEAMPLIFIER WITH DECIMAL PRESENTATION [DEMOLTIPLICATORE A 200 MHz CON PRESENTAZIONE DECIMALE DEL CONTENUTO]
18 Jun. 1965 12 p refs In ITALIAN *Its* Nota Interna No. 280 (LNF-65/19) CFSTI: HC $1.00/MF $0.50

A decimal counter which adapts a multistage system to single ring transistors is described. The counter consists of three components: a computation stage, which is constructed on a qui-binary scale; a null circuit which is composed of a 100 kc oscillator; and a presentation circuit, which is connected to the diodes of an oscilloscope. A description of the circuits, and diagrams are presented. Transl. by G.A.L.

N65-33183*# Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.
RANGER TV SUBSYSTEM (BLOCK III). VOLUME 4a: MANUFACTURING, PRODUCT ASSURANCE, AND TEST Final Report, Jul. 1961–Jul. 1965
22 Jul. 1965 234 p Prepared for JPL
(Contract JPL-950137)
(NASA-CR-64790; AED-R-2620) CFSTI: HC $6.00/MF $1.25 CSCL 09C

The special manufacturing techniques, reliability methods, and quality control methods employed on the Ranger television subsystem program are described and a history of its test program is presented. R.N.A.

N65-33184*# Radio Corp. of America, Princeton, N. J. Astro-Electronics Lab.
RANGER TV SUBSYSTEM (BLOCK III). VOLUME 4b: APPENDICES
22 Jul. 1965 388 p Prepared for JPL
(Contract JPL-950137)
(NASA-CR-64791; AED-R-2620) CFSTI: HC $7.00/MF $2.00 CSCL 09C

A history of malfunctions of equipment in the television subsystem for Ranger missions is presented in concise form. This list covers all malfunctions during the interval from the initiation of the split-system through final flight model testing prior to the launch of Ranger IX. Also given are tabulations involved in detailed reliability analysis for the subsystem components, a failure effects analysis for both the initial subsystem components, a failure effects analysis for both the initial subsystem and the later split-system configurations, a stress analysis for the Ranger designs following Ranger VI, and a standard parts list. J.M.D.

N65-33214# Texas Instruments, Inc., Dallas.
COMPOUND SEMICONDUCTOR FUNCTIONAL ELECTRONIC BLOCKS First Quarterly Progress Report, 15 Dec. 1963–15 Mar. 1964
[1964] 54 p ref
(Contract AF 33(615)-1275)
(TI-08-64-51 AD-460930)

New equipment for depositing chromium or iron doped semi-insulating GaAs was built and installed. Proper conditions for GaAs epitaxial deposition in the new reactor were established. Runs directed at achieving chromium doping were begun and CrO_2Cl_2, $CrCl_3$, and elemental Cr are being evaluated as dopants. Passive circuit elements were fabricated using zinc out of doped SiO_2 film diffusion techniques. It was recognized that an initial pure SiO_2 film sputter was needed prior to sputtering of the doped film to achieve element definition and isolation. The degree of control of sputtering conditions was experimentally assessed. Little success was achieved in the reactive sputtering for n-type impurities into SiO_2 films and subsequent diffusion. Work is in progress on defining a linear functional electronic block circuit which can be built within the scope of present component performance and technology. R.N.A.

N65-33231# Symetrics Engineering Corp. of Florida, Satellite Beach.
BROADBAND SPURIOUS-RADIATION DETECTOR, SYMETRICS ENGINEERING MODEL 302A Instruction Manual
21 Jan. 1965 328 p
(Contract AF 08(606)-6531)
(AD-463458)

An instructions handbook for the Model 302A spurious-radiation detector which was designed to detect low level RF signals in the 30-mc to 8.3-Gc frequency range, is reported. The instrument consists of a combination of commercially available test equipment and components integrated into a single unit. The spurious-radiation detector consists of a broadband spectrum analyzer, oscillator synchronizer, traveling wave tube preamplifiers, frequency meters, 1-mc marker generator, and assorted probes and in-line couplers. Presented are data on the theory of operation, general operating procedure, range and base maintenance, and installation. Included are schematic diagrams and a discussion of each subassembly and its use. S.C.W.

N65-33318# Cornell Univ., Ithaca, N. Y. Electrical Engineering Research Lab.
ELECTRON TUBE RESEARCH Tenth Quarterly Progress Report, 1 Mar.–31 May 1965
N. De Claris and J. S. Thorp [1965] 75 p refs *Its* Rept. No. 26
(Contract DA-36-039-AMC-00034(E))
(EERL-39; ECOM-00034-10; AD-468334)

The seven-digit band-passed matched filter waveforms indicate the feasibility of using the filter as both a coded-pulse generator and matched filter. The eight-amplifier divided-band system using constant-resistance networks was found to have many desirable properties. Numerical solution of the differential equation satisfied by the minimum dispersion radar signal is indicated. A signal waveform representing the optimum signal for band-limited high resolution radars was derived. A linear filtering method for automatically distinguishing between signals in linearly separable classes was found. Signal multiplication using the proposed sheet-beam tube circuit was achieved at low frequencies (20 kc/s). W.M.R.

N65-33324# General Electric Co., Owensboro, Ky. Receiving Tube Dept.
X-BAND TUBE-AND-CAVITY OSCILLATOR EVALUATION PROGRAM Second Quarterly Progress Report, 1 Mar.–30 May 1965
R. J. Walker and J. M. Connelly [1965] 22 p
(Contract DA-28-043-AMC-00414(E))
(Rept.-2; AD-469429)

A total of 117 type Y-1094 tubes were made and tested for D.C. characteristics. Of these, 74 were evaluated at X-band. Data are presented showing the relation between D.C. characteristics and X-band performance. Reduced life in initial tests is attributed to lower initial emission. Author

N65-33331# Texas Instruments, Inc., Dallas.
RESEARCH ON OPTOELECTRONIC FUNCTIONAL ELECTRONIC BLOCKS Interim Engineering Report No. 1, 1 Apr.–30 Jun. 1965
J. R. Biard 20 Jul. 1965 33 p
(Contract AF 33(615)-2643)
(TI-03-65-66; AD-468296)

Investigations of optoelectronic phenomena are being performed in an effort to extend the applicability of integrated circuits. In particular, the present effort is concerned with the application of optoelectronics to Functional Electronic Blocks (FEB's) which will perform functions requiring integrated arrays of solid state light sources optically coupled to arrays of detector circuits. Functions have been chosen which would be impossible or extremely difficult to attain with conventional solid-state technology. Task I is concerned with the design and fabrication of Optoelectronic FEB's. A commutator array and a read-only memory array have been selected for study. During this quarter the physical design of the commutator array was completed. Photomasks have been received and fabrication has begun. Work on the read-only memory array has been restricted to an investigation of the technology required to achieve oxide-isolation for the light source array. Task II is concerned with the optical and electrical investigations and experiments required to provide the technology and design information necessary to support Task I. During this report period, material investigations have been conducted with GaAsP and GaP with the aim of improving external quantum efficiency and to achieve shorter wavelength emission. Diffusion and processing experiments have been conducted to improve uniformity and yields. Author

N65-33359*# Varian Associates, Palo Alto, Calif.
RESEARCH ON AN ELECTROSTATICALLY FOCUSED KLYSTRON
D. G. Dow and R. J. Butwell Sep. 1965 75 p
(Contract NAS1-3972)
(NASA-CR-300) CFSTI: HC $3.00/MF $0.75 CSCL 09A

Design considerations and experimental work are presented for a variable output, high efficiency, electrostatically focused klystron. Electrical design considerations include the beam and focusing system, bandwidth, and high efficiency The mechanical design of the focusing system is given and experimental verification of the focusing technique, both with and without rf, is included. The electrical design parameters and other relevant parameters derived from them are given in tabular form. The general design areas considered from a mechanical standpoint consisted of mutually insulating the large number of positive and negative electrodes, maintaining tolerances of less than one mil due to the small size of the focus structure, and designing the entire tube to meet weight, vibration, and acceleration specifications. C.T.C.

N65-33381# CTS Knights, Inc., Sandwich, Ill.
CRYSTAL UNITS TYPE CR-(XM-11)/U, 1 TO 20 MC IN THE TYPE HC-27/U GLASS HOLDERS Progress Report, 1 Nov. 1964–31 Jan. 1965
R. E. Bennett [1965] 29 p
(Contract DA-36-039-SC-81274)
(PR-15; AD-616388)

Efforts directed toward development of capability to produced loaded quartz crystals in glass holders on a mass production basis are reported. In particular, two hardware designs were evaluated for use in the production process for mounting a 1 mc quartz plate in the glass holder. Shock and vibration tests of units yielded by the designs, and tests of electrical resistance, showed that neither approach is satisfactory. J.M.D.

N65-33383# Microwave Associates, Inc., Burlington, Mass.
SOLID-STATE MICROWAVE TR-ATR SWITCH PRODUCTION ENGINEERING MEASURES PROGRAM Final Engineering Report, 18 Apr. 1962–30 Sep. 1964
Paul Basken [1964] 237 p
(Contract DA-36-039-SC-86718)
(AD-615747)

In this report, the entire production engineering measures program is analyzed in three major sections covering the technical discussion of the contract work, a complete process specification, and an analysis of the quality control measures carried out. In the technical discussion, an effort is made to describe the design work in some detail. In addition, test results are summarized and an analysis is presented of the manufacturing problems. The process specification is intended to provide step-by-step instructions for the manufacture of switches by a competent manufacturer. The quality control section, in addition to listing all inspection positions, includes the final summarized results, technical analysis, and conclusions drawn of the production run tubes. Author

N65-33385# Union Carbide Corp., Cleveland, Ohio. Kemet Dept.
PRODUCTION ENGINEERING MEASURE FOR IMPROVED RELIABILITY OF SOLID TANTALUM CAPACITORS Progress Report, 1 Jan.–31 Mar. 1965
H. W. Holland [1965] 15 p
(Contract DA-36-039-AMC-03624(E))
(PR-7; AD-615958)

The Production Run, Activity 7.00, was completed through the phases of manufacture and accelerated life testing. Samples were tested to determine parametric values (dc leakage, capacitance and dissipation factor), and 100% go-no go testing of all parts to the limits of MIL C-39003 was partially completed. The contract failure rate goal of 0.001% per thousand hours was met. Typical parametric values are: 1. dc leakage—0.07 microamperes, 2. capacitance—21.2 microfarads, 3. dissipation factor—0.7%. Approximately 1,400 pieces, meeting all the requirements, were produced. Author

N65-33396# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CLASSIFICATION OF CONTACTLESS SYNCHRONOUS MACHINES
V. V. Apsit 30 Apr. 1965 27 p Transl. into ENGLISH from Tr. Inst. Energ., Akad. Nauk Latv. SSR (Riga), no. 12, 1961 p 23–48
(FTD-TT-65-118/1+2; AD-614941)

A general discussion of the development and classification of contactless synchronous machines is presented. The machines are divided into two classes: those with polarity of the main flux alternating in time (alternative machines), and those with constant polarity of the flux and flux magnitude alternation (pulsation machines). Both alternative and pulsation machines are broken down into radially excited and axially excited types. A brief discussion of the characteristics of various kinds of machines and their modifications, in addition to diagrams of several protype machines, is included. G.A.L.

N65-33462# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
PRODUCTION ENGINEERING MEASURE FOR SILICON OVERLAY TRANSISTORS Quarterly Progress Report, 1 Jan.–31 Mar. 1965
Thomas Kearkuff [1965] 46 p
(Contract DA-36-039-AMC-06156(E))
(QPR-1; AD-619295)

New base predeposition and base diffusion systems were put into production and evaluated. Work has been started on a new emitter and gold diffusion process. Work has been started on the emitter stripe width evaluation. Chemical etching has been placed into production and work on slurry polishing is almost complete. A new photoresist has been evaluated and production controls are presently being applied. New assembly parts and processes have been evaluated from the assembly viewpoint. Author

N65-33493# Texas Instruments, Inc., Dallas.
MOLECULAR ELECTRONICS FOR KADAR APPLICATIONS Interim Engineering Report No. 3, 1 Apr.–30 Jun. 1965
Tom M. Hyltin and Lafe R. Pfeifer, Jr. 31 Jul. 1965 81 p refs
(Contract AF 33(615)-1993)
(TI-03-65-80; AD-468798)

Technical details of work performed in signal power generation, signal reception, high-frequency signal processing, low-frequency signal processing, and equipment engineering are presented. An S-band power amplifier analysis is given and includes the construction of single and double stage breadboards. An 8307 geometry transistor was designed and tested. At 2.25 Gc, it produces 2 watts at 3 db gain with 40% efficiency. Signal reception functions include the fabrication of an X-band hybrid mixer on a silicon substrate. Single and two-stage I-F preamplifiers were built and an effort to reduce the amplifiers to monolithic form was initiated. Switching diodes were fabricated and tested in standard line packages. A circuit diagram was drawn to reduce the sum video amplifier to integrated form. Equipment engineering includes the construction of a 5 × 5 antenna matrix. The antenna element design centers around the use of a dipole. Radiation tests on this antenna are included. C.T.C.

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N65-32798# Massachusetts Inst. of Tech., Cambridge Operations Research Center.
DYNAMIC BEHAVIOR AND CONTROL OF COMMUNICATIONS NETWORKS
John U. Beusch. (Ph.D. Thesis) Jun. 1965 158 p refs
(Contract Nonr-1841(87))
(TR-13; AD-617723)

Analyzed is an arbitrary store-and-forward network where messages without priorities can enter at any node and be destined for any other node. The problem of routing messages is considered to be a feedback control problem in which information about the number of bits waiting at various places in the network is fed back to points where decisions are made. Developed were mathematical models which represent system behavior, and simple models which predict future queue lengths. Also developed were methods for reducing a set of series-parallel channels to a single equivalent channel, a method of determining message routing decision rules, and a method of determining whether and how often to obtain information about another part of the network. Cited are examples which illustrate the proficiency of the proposed methods and computer program. Also included are results of simulations to compare various routing techniques with the feedback technique. S.C.W.

N65-33003# Illinois Univ., Urbana. Antenna Lab.
ENERGY CONSIDERATIONS IN OPEN AND CLOSED WAVEGUIDES Technical Report No. 6
S. Laxpati and R. Mittra Jun. 1965 40 p refs *Its* Rept.-65-3
(Contract AF 19(628)-3819)
(AFCRL-65-222; AD-617251)

Energy relations derived for a lossless closed uniform and periodic structure show that the total complex Poynting vector integrated over the cross section is identically zero for the case of an arbitrary complex wave. These results are also applicable to open structures provided certain conditions are satisfied. The application of these results in the field of leaky wave antennas is discussed. Two illustrative examples, those of the sinusoidally modulated reactance surface and the sheath helix, are worked out. It is shown that although the slope of the k-β curve can no longer be associated with the direction of net power flow, the knowledge of the slope may still be helpful in selecting certain modes for representing a given source. Author

N65-33015# Notre Dame Univ., Ind. Dept. of Electrical Engineering.
A NEW DIAGRAM FOR FEEDBACK SHIFT REGISTERS
J. L. Massey and Ruey-wen Liu 28 Jul. 1965 19 p refs Presented at the 3rd Ann. Allerton Conf. on Circuit and System Theory, Univ. of Ill., 20–22 Oct. 1965
(Grant NSF GP-2547)
(EE-659)

A new and easily constructed diagram for feedback shift registers (FSR's) is developed which contains all the information on the traditional Good's diagram. The new diagram has the advantage that the diagram for m-stage FSR's is a subdiagram of that for (m+1)-stage FSR's. The usefulness of this new diagram, called an annular diagram, is illustrated by applications to the theory of stability of FSR's. Classes of annular diagrams are derived which guarantee the stability (or instability) of any FSR which satisfies any diagram in the class. The generalization to multi-point feedback registers is indicated. Author

N65-33057* Honeywell, Inc., Minneapolis, Minn. Military Products Group Research Dept.
AN APPROXIMATION TO LINEAR BOUNDED PHASE COORDINATE CONTROL PROBLEMS
E. B. Lee *In* NASA. Marshall Space Flight Center Studies in the Fields of Space Flight and Guidance Theory 12 Jul. 1965 p 223–246 refs (See N65-33050 21-30) CFSTI: HC $7.88/MF $2.50
(Contract NASw-986)

Described is an approximate solution procedure for linear control processes as described by the differential system:

$$\Sigma \dot{x} = A(t)x + B(t)u(t).$$

This procedure has the advantage that it encounters no discontinuities in the adjoint solution which determines the optimum controller, and therefore the resulting two point boundary value system can be more readily solved. G.G.

N65-33308# Northwestern Technological Inst., Evanston, Ill.
ON PROBABILISTIC GRAPHS AND SOME APPLICATIONS
Technical Report No. 13
Howard Frank Jun. 1965 93 p refs
(Grants AF-AFOSR-98-63; DA-ARO(D)-31-124-G223)
(AROD-3298-17; AD-468705)

Several physical systems are examined which have natural association with the linear graph. The linear graph model of the deterministic systems, i.e., communication networks and sequential machines, is shown to be inadequate in representing these systems when they are operating in real environments. The problem of random flow in communication networks is solved for the cases where flow distributions are either known or unknown. In the latter case, it is shown that a simple statistical testing procedure may be applied. The problem of improving communication networks whose maximum flow rate probability is too small is discussed. A flow problem is also considered in which error in the message routing is possible. The state behavior of a deterministic sequential machine with error in its state transition is analyzed and reliability indices are defined as a measure of the reliability. Author

N65-33358*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ILLUSTRATION OF DESIGN METHODS FOR POWER REDUCTION IN LOGICAL SYSTEMS
H. Allen Curtis Washington, NASA, Sep. 1965 21 p refs
(NASA-TN-D-3027) CFSTI: HC $1.00/MF $0.50 CSCL 09C

Power consumption in space communications and telemetry systems can be reduced considerably by the use of micropower transistor logic circuits and the incorporation of data compression techniques. In this report the additional importance of the conscientious use of systematic design procedures in the optimization of logic circuitry for such systems is emphasized. The primary goal of this report is to bring to the attention of logic designers many of the useful systematic methods developed in recent years. The medium used to reach this goal is the presentation of a design problem—the derivation of a comparator unit for a telemetry data system. It is shown that a judicious use of ingenuity and systemmatic methods affords considerable savings in both components and power over previous designs obtained by ingenuity alone. Author

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N65-32410*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-33, VOLUME IV, APRIL 1–MAY 31, 1965. SUPPORTING RESEARCH AND ADVANCED DEVELOPMENT
30 Jun. 1965 310 p refs
(Contract NAS7-100)
(NASA-CR-64605) CFSTI: HC $7.00/MF $1.75 CSCL 22

Space research is reported concerning numerical integration techniques, space flight energy sources and propulsion systems, spacecraft instrumentation, chemistry and metallurgy projects for space applications, and electronics and coding studies for communications systems. For individual titles see N65-32411–N65-32474.

N65-32434* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A PRESSURE TELEMETER FOR WIND TUNNEL FREE FLIGHT PRESSURE MEASUREMENT
R. G. Harrison, Jr. *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 105–112 refs (See N65-32410 21-11)
CFSTI: HC $7.00/MF $1.75

The pressure telemeter is a differential transducer that can be subjected to an overpressure of 50 psi without damage or change in performance. The reference pressure is obtained by a very slow leak into the large volume of the reference side of the sensor. This leak rate can be easily adjusted to provide stable measurement times as long as 5 sec at atmospheric pressure. As the ambient pressure goes down, this time can be increased. Performance, design, construction, calibration, recording instrumentation, operational techniques, and problems encountered are covered. On the basis of the results of the pressure telemetry development program in the hypersonic wind tunnel, the pressure telemeter is considered to be operational and capable of producing valid data. No special training or instrumentation is required to use the pressure telemeter. E.E.B.

N65-32705# Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.
SOME EFFECTS OF ATMOSPHERIC DISTURBANCES ON AN OPEN RETURN LOW SPEED WIND TUNNEL
Alain Gach Jul. 1964 79 p refs
(Contract AF 33(657)-12174)
(Rept.-700; AD-617761)

This report is concerned with the influence of atmospheric disturbances on an open circuit wind tunnel, and in particular the changes in tunnel velocity caused by external wind. Both analytical and experimental studies have been performed, considering first a steady wind, and then periodic gusts. The possibility of cancelling any change in tunnel velocity by means of an automatic variable pitch propeller has been investigated. This would improve the operation of the wind tunnel in the presence of gusts or winds. Author

N65-32732*# Aircraft Armaments, Inc., Cockeysville, Md.
DESIGN STUDY OF A DEVICE TO SIMULATE THE DYNAMIC ENVIRONMENT ENCOUNTERED UNDER CONDITIONS OF REDUCED OR ZERO GRAVITY Final Report
W. E. Baker, A. W. Criswell, H. E. Fineman, and W. S. Thayer Jan. 1963 285 p refs
(Contract NAS9-623)
(NASA-CR-64532; ER-2938) CFSTI: HC $6.00/MF $1.50 CSCL 14B

Presented is a design study of a reduced or zero gravity simulation device that is capable of simulating the motion of a man in space, and of mock-up vehicles, over a wide range of reduced gravity environments. This device has complete freedom of motion in all six body modes of motion, and incorporates two interchangeable support systems: one for the training of man in space, and the other for spacecraft mock-ups. The motion of the device can be programmed from forces generated by the payload, from control signals of the astronaut trainee, or from external drive signals. It was concluded that the construction of a simulator of limited size is feasible. Results of studies on desirable upper and lower limits of velocity and acceleration, sensing and control systems, programming of motion, safety considerations, and building designs are

included, together with recommendations for specific hardware and types of transducers. G.G.

N65-32932# CGS Scientific Corp., Southampton, Pa.
GASEOUS CONTROL SYSTEMS FOR ALTITUDE RESEARCH CHAMBERS A1, A2 AND A3—OPERATION AND MAINTENANCE MANUAL Final Report
R. L. Bundey 19 May 1965 45 p
(Contract AF 41(609)-2729)
(AD-465712)

A manual covering the operation and maintenace of the gaseous control system installed on certain altitude research chambers is presented. The system senses, records, and controls chamber relative humidity and oxygen partial pressure, and senses and records chamber total absolute pressure. Elements of this system described in the manual are oxygen control system, carbon dioxide control system, absorber loop, relative humidity system, sample gas system, and total pressure system. J.M.D.

N65-32990# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaire.
THEORETICAL STUDY, AND CONSTRUCTION, OF A SPHERICAL ELECTROSTATIC BETA SPECTROMETER [ETUDE THEORIQUE ET REALISATION D'UN SPECTROMETRE BETA ELECTROSTATIQUE SPHERIQUE]
Roger Moret (Ph.D. Thesis, Grenoble Univ.) 1964 72 p refs In FRENCH; ENGLISH summary
(CEA-R-2420) CFSTI: HC $3.00/MF $0.75

After a literature survey showing the importance of an electrostatic spectrometer with spherical electrodes for studying disintegration processes, the theoretical characteristics of such an apparatus are derived (determination of the trajectory equations—calculation of the transmission and of the resolving power—the case of a point source and of an extended source). The apparatus built as a result of these calculations is described. The electrostatic field distribution outside the electrodes is derived. As well as giving electron spectra (β disintegration and conversion electrons) the apparatus makes it possible to study e-γ, e-β, e-e-γ and e-e-β coincidences. In the last part are given experimental characteristics and the results of the first measurements made on conversion electron spectra (^{161}Tb, ^{151}Pm, ^{155}Eu) and on coincidences (^{170}Tm) using this spectrometer. Author

N65-33019# Midwestern Universities Research Association, Madison, Wisc.
THE DESIGN OF PROTON LINEAR ACCELERATORS FOR ENERGIES UP TO 200 MEV
B. Austin, T. W. Edwards, J. E. O'Meara, M. L. Palmer, D. A. Swenson (Los Alamos Sci. Lab.) et al 1 Jul. 1965 165 p refs Prepared for Argonne Natl. Lab.
(MURA-713) CFSTI: $5.00

A study of proton linear accelerators of energy up to 200 MeV using drift tube loaded cavities resonant at 200 Mc is described. Such an accelerator is useful as an injector for a high energy synchrotron. Two computer programs have been used extensively in this study; one is used to calculate the resonant frequency and rf fields in the appropriate linear accelerator geometry, the other is used to calculate particle motion in the accelerator. From the field computational program a variety of resonant cavity configurations have been investigated, and an optimum structure has been chosen on the basis of minimizing the rf power costs and the structure length costs. Several optimized sets of parameters for a linear accelerator are given. More detailed studies were done on one of the sets of parameters including particle dynamics studies. Tables of drift tube dimensions are given. Some details of mechanical models constructed to test design features are given. Author

N65-33143*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-33, VOLUME IV FOR THE PERIOD APRIL 1, 1965 TO MAY 31, 1965. SUPPORTING RESEARCH AND ADVANCED DEVELOPMENT
30 Jun. 1965 315 p refs
(Contract NAS7-100)
(NASA-CR-64594; JPL-SPS-37-33, Vol. IV) CFSTI: HC $7.00/MF $1.75 CSCL 22D

A documentation of current project activities and supporting research and advanced development efforts conducted for NASA space exploration programs is presented. Research is reported in the following areas: systems analysis, guidance and control, engineering mechanics, propulsion, space sciences, telecommunications, and quality assurance and reliability. S.C.W.

N65-33149*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TRACKING AND DATA ACQUISITION SUPPORT FOR THE MARINER VENUS 1962 MISSION
N. A. Renzetti 1 Jul. 1965 103 p refs
(Contract NAS7-100)
(NASA-CR-64611; JPL-TM-33-212) CFSTI: HC $4.00/MF $0.75 CSCL 14B

This document summarizes the technical activities of the Deep Space Instrumentation Facility in support of the *Mariner II* mission. The narrative includes a synopsis of the mission, a comprehensive account of the tracking operations, and a performance evaluation. The tracking and data acquisition support are also delineated, and a complete list of reference material is given. Author

N65-33156# Wyoming Univ., Laramie.
THE CONSTRUCTION AND OPERATION OF T-BURNER FACILITIES FOR THE STUDY OF OSCILLATORY COMBUSTION
Robert Joseph Croteau (M.S. Thesis) May 1965 64 p refs
(AD-617304)

The feasibility, construction, and operation of a one-dimensional T-burner is presented for the study of oscillatory combustion. Background material is given and includes theoretical considerations. A method of construction and operation of a laboratory facility is shown and the particulars of the burner and associated equipment are included. Factors such as location, safety considerations, and outside support are treated generally. A cost estimation is made for a proposed facility and the advantages of constructing and operating such a laboratory are pointed out. C.T.C.

N65-33174# Atomic Energy Commission, New York. Health and Safety Lab.
CONTROL OF LIQUID HYDROGEN HAZARDS AT EXPERIMENTAL FACILITIES: A REVIEW
A. A. Weintraub May 1965 258 p refs
(HASL-160) CFSTI: $6.00

The hazards of liquid hydrogen at experimental facilities are described and current techniques are presented for their control. As background, the uses of hydrogen, its general properties (Appendix A notes specific properties) and the design and materials for liquid hydrogen systems are discussed. Flame propagation, deflagration and detonation, ignition in free space and under confined conditions are considered under

fire and explosion hazards. The techniques of hazard control are examined in relation to hydrogen detection systems, ventilation, liquid hydrogen dump systems, flaring, ignition sources, explosion suppression, inerting, fire control and personnel exposures. Storage, transfer and transportation are also discussed. Appendix B contains case histories of hydrogen accidents. Two of the liquid hydrogen safety guides, cited among the 60 references, are reproduced in Appendix C.
Author

N65-33257*# RCA Service Company, Inc., Camden, N. J. Nuclear and Scientific Services Dept.
A LARGE ULTRA HIGH VACUUM ENVIRONMENTAL CHAMBER WITH LIQUID HELIUM COOLED WALLS
C. D. Elderkin and J. M. Bradford (NASA, Langley Station, Va.) [1965] 20 p Presented at the Tech. Meeting and Equipment Exposition at the Inst. of Environ. Sci., 21–23 Apr. 1965
(Contract NAS1-1918(c))
(NASA-CR-64769) CFSTI: HC $1.00/MF $0.50 CSCL 14A

Described is the construction and operation of an ultra-high vacuum environmental chamber with cryogenic walls at liquid helium temperatures. This chamber attains low pressures, similar to those in space, by a combination of diffusion pumping and cryogenic pumping. Schematics of the vacuum facility and the refrigerator are shown, and a detailed discussion of each of the components of the vacuum system is presented.
G.G.

N65-33349# Lockheed Missiles and Space Co., Sunnyvale, Calif.
GEMINI AGENA TARGET VEHICLE Reports Bibliography, 30 Jun. 1964
1 Sep. 1964 16 p
(Contract AF 04(695)-129)
(LMSC-A605144; AD-462886)

A bibliography on the Gemini Agena Target Vehicle is presented. It pertains to reports published prior to July 1964. Topics covered include communications and control systems, flight planning, human factors, various engineering manuals, presentations and briefing aids, product assurance, and propulsion system.
J.M.D.

N65-33425# Federal Aviation Agency, Atlantic City, N. J. Experimentation Div.
DEVELOPMENT OF RUNWAY MARKING MACHINE AND COLD-WATER PAINT FOR AIRPORT SURFACE MARKING Final Report
Nathaniel H. Twichell Apr. 1965 30 p
(RD-65-45)

A low-cost mobile spray unit was developed for applying experimental marking patterns on runway and taxiway surfaces. Speed of application and drying were essential since runway availability was critical; therefore, a cold-water paint was developed for use with the spray unit. The prototype paint spraying device was assembled from readily available stock components and tested. The cold-water airport paint, developed concurrently, proved compatible with the spray unit and possessed the required ease of handling and application qualities. Results of this prototype unit testing indicate that a mobile paint spraying device, similar to the type developed, would be well-suited to the task of marking runway and taxiway surfaces, particularly where frequent repainting of touchdown areas is necessary.
Author

N65-33443# Los Alamos Scientific Lab., N. Mex.
AN INERT ATMOSPHERE ENCLOSURE FOR THE PREPARATION OF SAMPLES PRIOR TO THE DETERMINATION OF OXYGEN
Maynard E. Smith, James M. Hansel, and Glenn R. Waterbury 27 Aug. 1965 13 p refs
(Contract W-7405-ENG-36)
(LA-3344) CFSTI: $1.00

An inert atmosphere enclosure was assembled by equipping a commercial glove box, constructed from acrylate and methacrylate resin, with a gas purifying and circulating system designed to remove water, oxygen, nitrogen, and carbon dioxide from the argon atmosphere. Linde molecular sieve 5A is used as the desiccant and carbon dioxide trap, and uranium turnings, heated to 640° C, serve as a getter. The water and oxygen concentrations are continually monitored, and an atmosphere containing less than 2 ppm of either constituent can be readily maintained while the box is in use; the concentrations decrease slowly when the box is not being used and the glove covers are in place. Nitrogen and carbon dioxide also are removed effectively by the purification system. Relative efficiencies of anhydrous magnesium perchlorate and molecular sieve as desiccants, and of heated copper and uranium turnings as getters, were investigated. A device is described that prevents atmospheric contamination of samples during transfer from the enclosure to an apparatus for determining oxygen.
Author

N65-33451# Stanford Univ., Calif.
TWO-MILE ACCELERATOR PROJECT Quarterly Status Report, 1 Jan.–31 Mar. 1965
Jun. 1965 102 p refs
(Contracts AT(04-3)-400; AT(04-3)-515)
(SLAC-45) CFSTI: $4.00

Details on the construction of a two-mile long linear electron accelerator, and site preparation, buildings, utilities, and associated work are reported. Among the areas discussed are plant engineering, systems engineering and installations, accelerator physics, instrumentation, heavy electronics, mechanical design and fabrication, klystron studies, beam switchyard, and pre-operations research and development.
C.T.C.

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N65-32439* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AXISYMMETRIC STEADY FLOW OF A SWIRLING COMPRESSIBLE FLUID THROUGH A CONVERGENT-DIVERGENT NOZZLE WITHOUT EXTERNAL HEAT TRANSFER
P. F. Massier *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 133–141 refs (See N65-32410 21-11)
CFSTI: HC $7.00/MF $1.75

Ambient temperature swirling flows through nozzles was investigated in conjunction with ionized gas-flow experiments. A combination of analysis and experimental results indicate that the swirling flow through a nozzle consists of essentially two types of swirling regions. A core exists in which the tangential velocity distribution is approximately that of solid body rotation. In the outer annulus the tangential velocity distribution is more nearly that of a potential vortex. A consequence of the analysis based on the simplifying assumptions is that the tangential component of the velocity depends only on the radial coordinate and not on the axial coordinate. Hence the expansion process results in an increase of only the axial component of the velocity. For the amount of swirl injected in

the test analyzed the tangential velocity dominated the axial velocity in most of the convergent part of the nozzle; whereas, the axial component dominated in the divergent part. E.E.B.

N65-32514 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE REFLECTION OF A SPHERICAL SHOCK WAVE IN WATER FROM A FREE SURFACE

B. I. Zaslavskiy *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 72–84 refs (See N65-32506 21-25)

Wave equation solutions are used for approximately solving the problem of nonlinear reflection of a spherical shock wave in water from a free surface. Weak shock waves are considered for the case when change of entropy upon transition of flow through shock front can be disregarded. Axially symmetric flows are also considered. A Cauchy problem is solved in order to determine the position of the shock front at any coordinate point. L.S.

N65-32519 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CERTAIN PROBLEMS ABOUT WAVES IN IDEAL LIQUID WITH ELASTIC BOUNDARIES

A. K. Pereverzev *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 132–142 ref (See N65-32506 21-25)

Wave equations are solved for finding the asymptotic resolution of the problem of the flow of an ideal liquid in a curvilinear band, by a method similar to that used for finding the asymptotic resolution of Dirichlet's problem in a narrow band in rectilinear regions. A solution for stationary waves (on an external ring shell) that are caused by the potential flow of an ideal incompressible liquid is presented, and a long wave solution is qualitatively investigated. L.S.

N65-32520 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

FLOW, AROUND A PLATE, OF A WEIGHTLESS LIQUID WITH FREE BOUNDARIES

A. V. Kuznetsov *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 143–152 refs (See N65-32506 21-25)

A solution is obtained for the problem of establishing the motion of a flat plate under the surface of a weightless liquid. A formula for lift is derived, and approximate formulas are obtained for small angles of attack and sufficiently large values of submersion. The method of solution is illustrated by numerical examples. The examples show that the life coefficient for a plate, during motion in a liquid, and limited by a free surface, is less than the corresponding coefficient in an infinite liquid, and increases with increasing submersion depth. L.S.

N65-32521 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ABOUT STAGNANT ZONES BEFORE A MOVING BODY

G. P. Cherepanov *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 153–156 refs (See N65-32506 21-25)

The problem of the formation of stagnant (dead) zones occurring before a body moving in a liquid that is contaminated by suspended particles (e.g. sand or earth particles) is considered for the case where the stagnant zone is filled with the particles. With certain assumptions, the problem is reduced to an analogous problem of flow around bodies where a cavity is formed, for the case when the cavitation number is smaller than zero. Formulas are examined, and various conditions for the problem are considered in an example. L.S.

N65-32522 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INTERACTION OF SUPERSONIC FLOW WITH AN OBSTACLE

F. V. Mugayev *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 157–161 refs (See N65-32506 21-25)

Experiments were conducted in a shock pipe of square section with an area of 8.1 cm^2 for investigating the motion of a shock wave appearing during the interaction of supersonic flow with an obstacle, over the interval of Mach numbers from 1.15 to 1.65. The dependence of the shock wave speed on time is shown, and the magnitude of the interval characterizing the transition from transient flow to established flow is measured and established by a high speed photographic method. Experimental data essentially agree with theoretical calculations for a mathematical model. L.S.

N65-32528 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PROBLEM OF TURBULENT DIFFUSION FOR INSTANTLY ENTERING IMPURITY

O. N. Prokof'yev *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 199–202 refs (See N65-32506 21-25)

A one-dimensional equation of turbulent diffusion is solved for determining the impurity concentration distribution for the non-stationary, one-dimensional problem of turbulent diffusion of a conservative impurity in a medium occupying a half space ($z \geq 0$), limited by plane $z = 0$. The entrance of impurity on the medium surface is assumed to be instantaneous. Initial and boundary condition formulas are considered in the calculations, and computations lead to a formula by which the concentration can be described. L.S.

N65-32529 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ABOUT THE EXCHANGE OF ENERGY DURING COLLISION OF PARTICLES WITH A SOLID WALL

V. B. Leonas *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 203–211 refs (See N65-32506 21-25)

Equations of motion are numerically solved for investigating the exchange of energy that occurs during the collision of a molecule (or atom) with a linear chain of atoms. Collision was considered for the cases where an external atom is connected elastically, and where the bond of the external atom with the chain is described by the Lennard–Jones potential. The dynamics of the collisions are discussed, and parameters are analyzed. Results of calculations show that the influence of oscillatory degrees of freedom of molecules on energy exchange can be very small. L.S.

N65-32533 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SOME DATA ON THE NONEQUILIBRIUM STATE OF CARBON DIOXIDE BEHIND THE FRONT OF A SHOCK WAVE

R. I. Soloukhin *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 233–238 refs (See N65-32506 21-25)

A shock wave was created in a shock tube, and the motion of the passing front and reflected waves was recorded by a streak-method on revolving photographic film through a narrow slot located along the axis of installation. Carbon dioxide was the gas used. Reflection scannings of shock waves for different Mach numbers were made. Curves are presented showing the dependence of the speed of a reflected shock wave on the speed of a passing wave for various assumptions concerning the thermodynamic equilibrium of the gas behind the front of the passing wave. The upper curve illustrates the calculation for an ideal gas with constant adiabatic coefficient γ 1.3 both in a passing and reflected wave. The middle curve is the delay

of dissociation of the gas behind the passing and reflected waves; and the lower curve shows full equilibrium for both a passing and a reflected shock wave. The data confirm the presence of full molecular vibrational excitation in the passing wave over the range investigated, and also indicate the absence of gas equilibrium dissociation both in passing and reflected waves. L.S.

N65-32539 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEPOSITS OF READILY SOLUBLE SALTS ON THE WALLS OF STEAM-GENERATING PIPES
I. G. Druker *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 273–279 refs (See N65-32506 21-25)

An attempt was made to estimate the growth of salt concentration on the internal wall of a steam-generating pipe from theoretical calculations, on the basis of the hydrodynamic transport theory, in an effort to explain the mechanism of variation in salt deposition accumulation along different areas of the pipe. In the calculations, parametric values close to those used in practice were taken. The results show that in all cases considered, the growth of salt-content in the boundary layer is small and is insufficient for forming a saturated solution. Thus the salt deposits actually found on the walls of steam-generating pipes cannot be explained, even if the walls are washed by water. L.S.

N65-32540 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON CONDITIONS OF STABILITY OF CERTAIN REGIMES OF MOTION OF GAS-LIQUID MIXTURES IN VERTICAL PIPES
Yu. L. Sorokin *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 280–291 refs (See N65-32506 21-25)

Experimental data on critical flow velocities from various processes are considered in a single system of dimensionless parameters for determining the appearance of a number of critical phenomena in gas-liquid mixtures. Various combinations of mediums composed of air, water, diethylene glycol, glycerine, steam, and saponaceous water were investigated at atmospheric and higher pressures for studying the conditions of stability (foam, bubble, shell, film, and others) for the regimes of motion in the flowing mixtures. Transition from one regime to another usually occurs as a result of the loss of stability of the previous structure. Also considered was the transition of the flooding process to other conditions as a result of changes in the velocity of one or more of the components of the mixture. L.S.

N65-32707# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center.
ON THE PRESSURE LOSS OF TURBULENT FLOW THROUGH CURVED PIPES (REPORT 1)
Hidesato Ito Jun. 1965 19 p refs Transl. into ENGLISH from Mem. Inst. of High Speed Mech., Tohoku Univ. (Sendai), v. 76, 1952 p 63–76
(RSIC-425; AD-618204)

A problem is considered in which the radius of curvature of the bend is considerably greater than the radius of the pipe. Attempts in the past to treat pressure loss in turbulent flow by a simpler parameter involving various radii and Reynolds number were not successful. It is shown that such a parameter actually exists and can be represented by $[Re\ (a/R)^2]^{1/5}$. This parameter is used to express the pressure loss of a turbulent flow through a curved pipe by a simple equation. R.W.H.

N65-32791# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ANALYSIS OF SUPERSONIC PERFECT GAS FLOW AROUND ELLIPTIC CYLINDERS
S. M. Gilinskii and M. G. Lebedev 15 Jan. 1965 8 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. (Moscow), no. 3, 1965 p 182–186

A numerical solution of the problem of supersonic perfect gas flow around planar bodies is described. The influence of the Mach number and the body shape on the geometric picture of the flow and on the distribution of the gas dynamic parameters is investigated. The presence of a more acute change in all the parameters in the transonic domain than in the axisymmetric flow case is indicated, making methods in which the approximation from the shock to the body is applied, difficult. A comparison with the results of the analysis of the flow around a circular cylinder by the integral relations method and by experiment is presented. W.M.R.

N65-32796# California Univ., Berkeley. Inst. of Engineering Research.
MEASUREMENT OF PRESSURES AND HYDRODYNAMIC FORCES ON A SHIPLIKE MODEL OSCILLATING IN A FREE SURFACE
Hou-wen Huang Jan. 1965 61 p refs
(Contract Nonr-222(93))
(NA-65-1; AD-618418)

The distribution of pressures, heaving forces, added-mass, and damping coefficients along the length of an oscillating ship model are investigated. These factors are obtained in two ways: first, by direct force measurement and then, by integrating the vertical components of pressures over the wetted surface of the model. Experimental results, presented in graphical form, are compared with two-dimensional, and three-dimensional theory and strip calculation. Results indicate that at the midship-section the three-dimensional effects on the heave force are negligibly small. At the end sections the three-dimensional measurement gives a smaller heave force at lower frequencies and a larger heave force at higher frequencies than does the two-dimensional theory or measurement. The minimum heave force was found to occur at a frequency lower than that predicted by the two-dimensional theory. An equation for pure heaving is developed. M.R.W.

N65-32854# Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.
TRANSONIC FLOW THROUGH CONVERGING-DIVERGING NOZZLES OF ELLIPTICAL CROSS SECTION
E. H. Ingram Aug. 1965 49 p refs
(R-152)

A simple, but approximate form of the equation of motion for potential flow is derived for the transonic flow field in an elliptical nozzle. The approximate equation is solved by means of a double power series. The solution shows that thermodynamic and gasdynamic properties are constant along elliptic paraboloids. For the special cases of axially symmetric and plane nozzle flows, the solutions become identical to those obtained by Sauer. Author

N65-32930# Naval Wepons Lab., Dahlgren, Va.
ON THE BIRTH AND DECAY OF VORTICES
Hans J. Lugt and Ernst W. Schwiderski Apr. 1965 53 p refs
(NWL-1972; AD-615770)

Complete sets of time-dependent solutions for Stokes slow-motion equations are constructed by means of a generalized separation technique, which was recently introduced and applied by the authors to steady-state flows. Under certain boundary and regularity conditions, such integrals of slow motion can be used to derive solutions of the quasi-linear Navier-Stokes equations in an exact linear manner. The classes of separable solutions, which are presented in this paper, reveal significant mathematical properties of laminar motions concerning their uniqueness and regularity. From the physical

point of view, they render valuable information on the mechanism of growing and dying vortices. For instance, it can be shown that a decaying discontinuity line is a process which involves the gradual obliteration of a discrete spectrum of vortices in such a way that little vortices with large damping coefficients dominate first, and that bigger vortices of fewer number replace them with advancing time. This model conforms with photographs by Weske and Rankin. Furthermore, the development and decay of individual vortices together with their energy supply are investigated. Author

N65-32939# Polytechnic Inst. of Brooklyn, Farmingdale, N. Y. Dept. of Aerospace Engineering and Applied Mechanics
THE POTENTIAL FLOW DUE TO A JET AND A STREAM WITH DIFFERENT TOTAL PRESSURES
Lu Ting, Paul A. Libby, and Charles Ruger Oct. 1964 34 p refs
(Contract DA-44-177-AMC-91(T))
(PIBAL-855; AD-465190)

A simple model of a jet injected into a moving stream with stagnation pressure lower than that of the jet is introduced to demonstrate the fundamental theoretical problems associated with the wing fan. The governing equations for this basic problem are formulated and reduced to a set of non-linear integral differential equations. An iteration scheme for the numerical solution of this problem is outlined. For the limiting case of a large stagnation pressure ratio, the non-linear integral differential equations can be simplified. Nevertheless the problem still has to be solved numerically by iteration methods. For the limiting case of small difference in stagnation pressure, a perturbation procedure is introduced. The basic solution, as expected, should be the classical solution of the free streamline problem with uniform stagnation pressure. The singularity of the perturbation solution near the stagnation point of the main stream is analyzed. The singularity is removed by a modification of the basic solution. The analytical behavior of the perturbation solution at large downstream distances is analyzed so that a class of functions admissible for representation of the perturbation solutions are defined. The problem of obtaining the perturbation solution is then reduced to the solution of simultaneous algebraic equations. Author

N65-32951*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CALCULATIONS OF MASS-FLOW AND THRUST PRODUCED FOR A TWO-PHASE FLUID MIXTURE PASSING THROUGH A CHOKED NOZZLE
Wyley D. Ward (Brown Eng. Co.) 4 Aug. 1965 32 p refs
(NASA-TM-X-53269) CFSTI: HC $2.00/MF $0.50 CSCL 01A

Analytical models are presented for calculating mass flow and thrust produced for a two-phase fluid mixture passing through a choked orifice or a converging-diverging nozzle. The solutions for both frozen and shifting equilibrium flow assumptions give comparable results, yet overcome difficulties encountered with previously used models. These solutions, purely analytical, are applicable for any liquid-vapor fluid mixture and require only nozzle inlet conditions for making calculations. Author

N65-33009# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF FLOW TWIST ON THE CHARACTERISTICS OF NOZZLE GRIDS
G. A. Fillipov and Chzhun-tsien Wan 7 Jul. 1965 16 p refs
Transl. into ENGLISH from Teploenerg. (Moscow), no. 5, 1964 p 54-57
(FTD-TT-65-686/1+2+4; AD-618047)

Flow twist at the input end of annular nozzle grids is shown to improve the otherwise low effectiveness of the root sections. Creation of this twist reduces the negative effect of the input diffuser in front of the grid, and increases the separation of moisture in the section in front of the nozzle apparatus. Combined use of flow twist and curvilinear blades can be expected to reduce losses in the grids even further. J.M.D.

N65-33290# Deutsche Versuchsanstalt für Luft-und Raumfahrt, Aachen (West Germany). Institut für Theoretische Gasdynamik.
THE HEAD-SHOCK AT AN OSCILLATING PROFILE [DIE KOPFWELLE AN EINEM SCHWINGENDEN PROFIL]
I. Teipel Jul. 1965 23 p refs In GERMAN; ENGLISH summary
(DLR-FB-65-30; DVL-424) CFSTI: HC $1.00/MF $0.50

In this report formulas for the calculation of shock waves at oscillating profiles have been derived. As a special case the problem of low supersonic flow has been discussed. The profile may perform oscillations of vertical translation and of rotation. Author

N65-33323# AVCO-Everett Research Lab., Everett, Mass.
TRANSITION AND STROUHAL NUMBERS FOR THE INCOMPRESSIBLE WAKE OF VARIOUS BODIES
A. Goldburg and B. H. Florsheim Aug. 1965 25 p refs
(Contracts DA-30-069-ORD-1955; DA-19-020-AMC-0210; Proj. Defender)
(AVCO-Everett Res. Rept.-229; AD-468984)

Incompressible wakes behind three-dimensional bluff bodies have been studied in order to gain information about the effects of body geometry. The results of Magarvey and Bishop achieved by dropping liquid droplets through another liquid were duplicated using solid spheres and observations were made of the wakes of bodies of various shapes, particularly cones. It was found that wake transition, defined as the first occurrence of finite unsteadiness, could be approximately correlated for a range of spheres and cones by a Reynolds number based on the total wake momentum thickness, $\theta^2 = C_D A/2\pi$, $Re_{\theta_T} \approx 95$. The cases of the teardrop and the disc deviate from this correlation and explanations are discussed. It was also found that for regular vortex shedding, the data for spheres and cones could be correlated with the Rayleigh–Strouhal formula based on θ:

$$S_\theta = 0.305\left(1 - \frac{95}{Re_\theta}\right)$$

Constraining the body to travel along a wire, thus reducing body-fluid interactions, produced an aperiodicity in the shedding phenomenon but left the value of the Strouhal number effectively unchanged. Author

N65-33343# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering.
STUDIES ON DISSOCIATING GASDYNAMICS. PART I: ON THE LINEARIZED DISSOCIATING GASDYNAMICS
Ting Y. Li and Shu J. Hsia Jul. 1965 53 p refs
(Grant AF-AFOSR-416-64A)
(AE-6501; AFOSR-65-0849; AD-468603)

After a brief review of some recent advances in the study of the inviscid nonequilibrium gasdynamics and of the linear nonequilibrium flow equations, a small disturbance solution is obtained for a dissociated diatomic gas flowing around a straight two-dimensional corner. The analysis is based on a small disturbance technique in which small departure from free stream conditions are assumed. Under the small disturbance approximation, the gasdynamic equation and atom mass rate equation for a dissociated diatomic gas can both be linearized. A method of superposition to solve these linearized partial differential equations is then developed through the application of the well known Green's theorem. An "oxygen-like" ideal dissociating gas

is used as an example in calculating the flow around a straight corner in a supersonic stream. The variation of flow properties at wall condition in the relaxation zone are found and compared with Clark's solution. The results show they are in fair agreement. Author

N65-33353*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MOTION OF LIQUID-VAPOR INTERFACE IN RESPONSE TO IMPOSED ACCELERATION
William J. Masica and Donald A. Petrash Washington, NASA, Sep. 1965 23 p refs
(NASA-TN-D-3005) CFSTI: HC $1.00/MF $0.50 CSCL 20D

As a part of the general study of the behavior of liquid propellants stored in space-vehicle tanks while exposed to weightlessness, an experimental investigation was conducted to determine the motion of the liquid-vapor interface in a cylindrical container in response to a constant translational acceleration. The imposed acceleration was applied parallel to the longitudinal axis of the cylinder and was directed positively from the vapor to the liquid phase separated by an initially highly curved interface. The results indicated that the liquid-vapor interface profile assumes the form predicted by the inviscid potential theory of G. I. Taylor. The rate at which the vapor phase penetrates the liquid phase (the ullage velocity) was empirically correlated as a function of known systems parameters for Bond numbers greater than 1 and fluids possessing low viscosities. The leading edge of the liquid-vapor interface was found to accelerate over distances comparable to fineness ratios of 2; the magnitude of acceleration is a known function of ullage velocity. Author

N65-33395# Naval Ordnance Lab., White Oak, Md.
UNCLASSIFIED REPORTS PUBLISHED BY THE AEROBALLISTICS AREA, 1 OCTOBER 1945–31 DECEMBER 1962
Betty M. Thompson May 1965 95 p
(NOLTR-64-222; AD-614700)

A list of all Naval Ordnance Laboratory Unclassified reports published by the Aeroballistics Area during the period 1 October 1945 through 31 December 1962 is presented. Author

N65-33400# Naval Ordnance Lab., White Oak, Md.
CHARACTERISTICS OF THE TURBULANT BOUNDARY LAYER WITH HEAT AND MASS TRANSFER AT M = 6.7
James E. Danberg 19 Oct. 1964 192 p refs
(Aerodyn. Res. Rept.-228; NOLTR-64-99; AD-452471)

Transpiration from a porous surface into a turbulent boundary layer is a possible method for protecting aerodynamic surfaces from severe heating rates associated with hypersonic speeds. Air transpiration and wall temperature effects on skin friction drag, heat transfer, and other boundary layer characteristics were determined from measurements on a porous flat plate in a wind tunnel at a Mach number of 6.7. Heat and mass transfer effects on the distribution of Mach number, static and total temperature, and velocity were measured from which skin friction coefficient; Stanton number; and total, momentum, displacement, and energy layer thicknesses were determined. Lowering the wall temperature decreased the total and displacement thicknesses and increased the momentum and energy thicknesses. All boundary layer thicknesses increased linearly with increasing injection rate. Velocity distributions are described by a Prandtl mixing length analysis in which the velocity profile is transformed into a form similar to the semi-logarithmic profile of incompressible flow. The integration constant of the mixing length velocity profile increases with heat transfer rate and decreases with increasing mass transfer rate. R.N.A.

N65-33433# Los Alamos Scientific Lab., N. Mex.
HASTII A NUMERICAL CALCULATION OF TWO-DIMENSIONAL LAGRANGIAN HYDRODYNAMICS UTILIZING THE CONCEPT OF SPACE-DEPENDENT TIME STEPS
Phillip L. Browne and Martha S. Hoyt 2 Sep. 1965 29 p refs
(Contract W-7405-ENG-36)
(LA-3324-MS) CFSTI: $2.00

A numerical experiment is described in which an attempt was made to reduce the calculation time of a two-dimensional, Lagrangian, hydrodynamics code, without loss of accuracy. The reduction was accomplished by utilizing a space-dependent time step; i.e., the frequency with which a point is calculated depends on the rate at which changes are occurring in the vicinity of the point. This system permitted savings to be made by eliminating calculations in regions undergoing relatively slow changes. Author

N65-33470# Cornell Univ., Ithaca, N. Y. Sibley School of Mechanical Engineering.
AN ANALYTIC STUDY OF FILM BEHAVIOR IN HORIZONTAL ANNULAR TWO-PHASE FLOW
R. H. Pletcher and H. N. Mc Manus, Jr. 30 Apr. 1965 86 p refs
(Grant DA-ARO(D)-31-124-G188)
(AROD-3199-1; AD-619308)

The behavior of a thin liquid film originally of annular cross-section was examined insofar as depth and velocity field were concerned when the film was exposed to high shear on the free surface and the action of gravity. The applicable equations were developed from the Navier-Stokes set, and include the terms necessary for cross flow of the fluid. These equations were resolved by formulating the equivalent finite-difference forms and effecting a numerical solution. The film behavior was determined when the surface was subjected to various stimuli, e.g., surface shear a function of film depth, surface cross shear, etc. Solutions were effected for several combinations of liquid flow and surface shear in a horizontal tube two inches in diameter. The results obtained compare favorably with experimental measurements both from a qualitative and quantitative view. The scaling laws, which permit the several solutions presented to be extended to a whole family of flows, are presented and discussed. The techniques of solution developed in this report are believed applicable to a wide variety of free surface flow problems. Author

N65-33492# Gyrodyne Co. of America, Inc., St. James, N. Y.
HYDRODYNAMIC TESTS OF A SCALE MODEL OF A MODEL QH-50C DRONE EQUIPPED WITH A GYROSTABILIZED FLOAT SYSTEM Final Report
Jun. 1965 57 p refs
(Contract NOw-63-0463-c)
(RD47-313400-2; AD-468856)

Hydrodynamic tests were conducted on a 1/5-scale model of a helicopter drone incorporating a "gyro-stabilized" float system. Fuselage stabilization within ±1° was demonstrated under conditions representing waves of 2.0–2.5 ft height in full scale. Indications are that considerably more severe sea states could readily be accommodated. Power requirements were shown to be small. It is concluded that the test results constitute strong evidence of feasibility of the concept in full scale. Author

N65-33510# Los Alamos Scientific Lab., N. Mex.
MEASUREMENT OF HELIUM AND HYDROGEN VISCOSITIES TO 2340° K
F. A. Guevara and W. E. Wageman 2 Sep. 1965 41 p refs
(Contract W-7405-ENG-36)
(LA-3319) CFSTI: $2.00

This paper describes an apparatus used to measure the viscosities of helium and hydrogen in the temperature range from room temperature to 2340° K. A capillary viscometer with a relatively short channel was used to make the measurements. A series of corrections is detailed, and the experimental technique of eliminating the effects of some of them is given. The results are presented as viscosity ratios relative to the viscosities at 283° K. Author

N65-33522# Bureau of Ships, Washington, D. C.
A PRELIMINARY HYDROFOIL DESIGN INCORPORATING A CAVITATION FREE OPERATION REQUIREMENT
William D. Bauman Dec. 1964 37 p
(AD-612672)

Continued research focusing on the development of a procedure for the hydrofoil designer which incorporates the avoidance of cavitation is reported. Discussed is a cavitation prediction technique which was developed on the basis of model test data. To verify the prediction technique, a set of hydrofoils were designed for a proposed hydrofoil ship. Included is a discussion of the preliminary design procedure for the hydrofoils with primary consideration given to avoiding cavitation. Conclusions are pending further model test results, and data from parametric variation studies. S.C.W.

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N65-32451* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SOIL STUDIES—MICROFLORA OF DESERT REGIONS. VII: ABUNDANCE OF CHEMICAL ELEMENTS IN AN AREA OF SOIL AT WHITE MOUNTAIN RANGE, CALIFORNIA
R. E. Cameron and G. B. Blank *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 203-208 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

A comparison of chemical bundance of 25 elements was made for 18 samples from the surface of a relatively arid soil field plot at the White Mountain Range, California. In decreasing order of abundance, these elements included O, Si, Al, K, Na, Fe, Ca, Mg, C, Ti, H, Mn, N, P, Sr, Ba, Zr, Cr, V, Ga, Cu, S, Ni, B, and Co. There was little deviation in the abundance of any element from the 18 samples analyzed from the soil field plot. Variation in the chemical abundance of the elements was also comparable to the small variability found in the microflora from the same field plot. All chemical elements were present in sufficient abundance for microbial activities. Although the total abundances of Fe, Na, and K showed substantial differences compared to typical well-developed agricultural soils, there was no apparent effect on the kinds of microflora found in these soils. E.E.B.

N65-32691# Kiruna Geophysical Observatory (Sweden).
MICROPULSATION MEASUREMENTS ON THE GROUND SURFACE Scientific Report No. 3
S. Westerlund Mar. 1965 41 p refs
(Contract AF 61(052)-619)
(AFCRL-65-388; AD-618336) CFSTI: HC $2.00/MF $0.50

Theory and literature concerning the behaviour of electromagnetic waves near the ground surface are reviewed. Special attention is paid to micropulsation frequencies. Author

N65-32698# Princeton Univ., N. J. Dept. of Geology.
THEORETICAL CALCULATION OF THE SPECTRUM OF FIRST ARRIVALS IN LAYERED ELASTIC MEDIA
Robert A. Phinney Jun. 1965 51 p refs
(Contract AF 49(638)-1243; ARPA Order 292-63)
(AD-617746)

A practical method for the calculation of the spectral parameters of first-arriving signals in seismology has been the object of much theoretical work in recent years. Attempts to transform the solution into a generalization of the normal modes have been a mathematical success only. Because of the complexity of this solution, a different, less elegant approach is demanded. A practical technique is proposed. By a change of variable, the twice transformed solution is separated into a product of the form $f(u).e^{-juR}$. This can be integrated with respect to the phase variable u, using standard quadrature methods, with the real part of u changing most rapidly along the integration path. By making the frequency complex, it is possible to displace any singularities away from the vicinity of the contour. This gives the spectrum of the signal as viewed through an exponentially decaying time window, making it possible to work with the first arrival by itself. Author

N65-32730*# Pittsburgh Univ., Pa. Dept. of Physics.
SOME CONSIDERATIONS CONCERNING RADIATION TRANSPORT IN THE OI 1304 TRIPLET IN THE UPPER ATMOSPHERE
T. M. Donahue 27 May 1965 45 p refs
(Contract NASr-179; Grant NsG-416)
(NASA-CR-63777; SRCC-7) CFSTI: HC $2.00/MF $0.50 CSCL 04A

Radiation transport in an optically thick medium where the natural wings of the lines are important is discussed in connection with the 1304 OI triplet observed in the upper atmosphere. Resonance scattering of sunlight will lead to an altitude variation of the airglow lines like the one observed but predicts only 2 kR peak intensity at 185 km for solar lines 0.2 Å wide. Similarly the intensity observed at 1356 Å in the forbidden oxygen transition ($^5S \times {}^3P$) is far too great to be resonance scattering of solar radiation. Author

N65-32739# Shell Development Co., Houston, Tex. Exploration and Production Research Div.
SEISMIC NOISE IN DEEP BOREHOLES Final Report, Mar. 1963-Feb. 1965
A. J. Seriff, J. H. Rosenbaum, C. J. Velzeboer, and R. J. Haase 21 Jun. 1965 94 p
(Contract AF 19(628)-2785; ARPA Order 292; Proj. Vela-Uniform)
(AFCRL-65-490; AD-618400)

Seismic noise in the frequency range 0.2 to 5.0 cps was observed in three wells approximately 10,000 feet deep. The wells are in the Texas Gulf Coast, the Val Verde Basin of West Texas and the Williston Basin of North Dakota. Observations were made at 1000 foot intervals in each well and simultaneous observations were made in a 500 foot reference hole and at four surface stations approximately 1500 feet apart. These seismometers were vertical component Benioffs. Two surface horizontal components were also recorded. Power spectral ratio, coherence and cross correlation phases were computed for most seismometer pairs, particularly the deep well seismometer and the 500 foot reference. The theoretical response of appropriate plane layered elastic models to trapped Rayleigh and Love waves as well as to plane P, SV, and SH waves incident from below was investigated in detail over the applicable frequency range for each of the three sites. Two essentially independent models for the noise have been investigated. Author

N65-32859# Washington Univ., Seattle.
EVALUATION OF INFRARED EMISSION OF CLOUDS AND GROUND AS MEASURED BY WEATHER SATELLITES
Clifford Dalton Kern (Ph.D. Thesis) 10 Nov. 1964 159 p refs
(Contract AF 33(608)-1129)
(AD-617417)

To test effects of emissivity on weather satellite window radiation data, a device was constructed to determine emissivity of various natural surfaces. Most terrestrial materials have window emissivities ranging from 85 to 98%; laboratory results show almost no materials to be black in the window region and, except for a few specially polished materials, no low values. The emissivity of water, with a value of 99%, is lowered between 2 to 4% when covered with a thin film of oil. Window emissivity of clouds is estimated to range between 90 and 100%. A computer program was used to correct for atmospheric effects the Tiros window radiation observations made over the Mediterranean Sea and North African deserts. The infrared blackness of the water surface is thus confirmed; for the desert regions there are anomalous differences between surface and corrected satellite temperature and additional corrections are made to determine emissivity values which correlate well with the geologic nature of the surface as well as with laboratory results. It is shown that even the crude filters of the Tiros radiometers permit geologic interpretations. M.W.R.

N65-32865# Ohio State Univ., Columbus.
AN INVESTIGATION OF VARIOUS METHODS OF SECOND ORDER LONGITUDE DETERMINATIONS
Edward Robert Therkelsen (M.S. Thesis) 1965 96 p refs
(AD-617297)

Different methods of second order longitude determinations were investigated and evaluated. The equipment used, the corrections for inherent errors, and the determination of star positions are discussed. For each determination method, the basic principle of the method, the preparation of the observing list, the observation method, the reduction of data, and the results are discussed. An example of the computations is included in the appendices. It was found that some methods were more accurate than others while other methods, though less accurate, required a great deal less preparation for observing or less computations to arrive at the final results. The results for each method are tabulated. The description of each method contains sufficient information to provide an operating procedure for anyone desiring to determine longitude by one of the methods. R.N.A.

N65-32888# National Physical Lab., New Delhi (India). Radio Research Comm.
IONOSPHERIC DATA
Dec. 1963 66 p
(RRC-A103) CFSTI: HC $3.00/MF $0.75

Ionospheric data, reported by nine stations in India, are presented, and relevant information on the geographic, geomagnetic, and magnetic location of each station is included. Related geophysical data are used to supplement the observations. M.G.J.

N65-32981# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
STUDY OF THE BEHAVIOR OF ARTIFICIAL RADIO-ACTIVE AEROSOLS. APPLICATIONS TO SOME PROBLEMS OF ATOMSPHERIC CIRCULATION [ETUDE DU COMPORTEMENT DES AEROSOLS RADIOACTIFS ARTIFICIELS. APPLICATIONS A QUELQUES PROBLEMES DE CIRCULATION ATOMOSPHERIQUE]
Gerard Lambert (Ph.D. Thesis—Paris Univ.) 1964 212 p refs
In FRENCH; ENGLISH summary
(CEA-R-2347) CFSTI: HC $6.00/MF $1.25

The aim of this work consists in the examination of the behaviour of radioactive aerosols produced in the atmosphere by nuclear explosions, in order to deduce the most general laws governing atmospheric circulation and diffusion. After having given a general table of the radiqactive aerosols present the authors consider the validity and the precision of the measurement methods and the concentration of the aerosols at ground level and in the upper atmosphere, as well as their deposition on the ground. The existence is thus demonstrated of a trophospheric equatorial barrier and of discontinuous and seasonal aspects of stratosphere-troposphere transfers. The role is shown of precipitations and dry auto-filtration in the lower atmosphere cleaning processes. This work makes it possible to describe the general behaviour of dust from the stratosphere, and to improve the total radio-active contamination of the globe. Author

N65-32995# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
RADON AND ITS SHORT-LIVED DAUGHTER PRODUCTS IN THE LOWER ATMOSPHERE [LE RADON ET SES DERIVES A VIE COURTE DANS LA BASSE ATMOSPHERE]
Jean Servant (Ph.D. Thesis, Paris Univ.) 1964 71 p refs
In FRENCH; ENGLISH summary
(CEA-R-2434) CFSTI: HC $3.00/MF $0.75

The variations of vertical and temporal distributions of natural radioactivity with geographical location in the lower atmospheric layers are shown. The content of radon and its short-lived daughters products are measured. Radioactive equilibrium between radon and its daughter products is realized when the atmosphere is stable. Air observations between 0 and 100 meters above the ground point out that radon and its decay products are valuable tracers to mark the stability of the atmosphere. Under very stable nighttime conditions the radon accumulates in the former 30 meters of the air layer, at sunrise it ascends and at 9 o'clock attains 100 meters high. The removal rate of the air in the lower atmosphere is computed from the movement of this radon mass, it is equal to 90 percent for a summer day. We have shown that this randon comes from the soil in which it diffuses by Brownian motion the intensity of which varies with the water content of the soil. Author

N65-33032# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
DAILY MEASUREMENTS OF NATURAL AND ARTIFICIAL RADIOACTIVITY IN 1960 [MESURES JOURNALIERES DE LA RADIOACTIVITE NATURELLE ET ARTIFICIELLE DANS L'AIR EN 1960]
Jean-Claude Philippot 4 Jul. 1964 31 p In FRENCH; ENGLISH summary
(CEA-R-2526) CFSTI: HC $2.00/MF $0.50

Daily numerical results of measures concerning β activity of the air, either from natural, owing to thorium, or from artificial, owing to active aerosols origin, will be found in this statement. All results are expressed in $\mu\mu$curie/m^3 of air. Proceedings of measure and technics of standardization, which were the topics of preceding papers, have not been discussed here. Author

N65-33092# Chicago Univ., Ill. Cloud Physics Lab.
[CLOUD PHYSICS]
1 Jun. 1965 61 p refs Papers Presented at the Intern. Conf. on Cloud Phys., Tokyo, 24 May–4 Jun. 1965 Sponsored in Part by NSF and Weather Bur.
(TN-30)

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3. IDENTIFICATION OF ICE NUCLEI IN THE ATMOSPHERE H. R. Byers 6 p refs (See N65-33095 21-13)

4. GLOBAL ASPECTS OF THE PRODUCTION AND DISTRIBUTION OF GIANT SEA-SALT PARTICLES Y. Toba 13 p refs (See N65-33096 21-13)

N65-33095 Chicago Univ., Ill. Cloud Physics Lab.

IDENTIFICATION OF ICE NUCLEI IN THE ATMOSPHERE

Horace R. Byers *In its* [Cloud Phys.] 1 Jun. 1965 6 p refs (See N65-33092 21-13)

In investigating the theory that the predominant ice nucleating agents in natural clouds are of terrestrial origin, previous work was reviewed, and measurements were undertaken. An electron microscope method of examining nuclei in newly-formed crystals is described, and the classification totals and temperature of crystal formation are tabulated for 250 ice-crystal replicas. Results indicate that the majority of identifiable particles assumed to be ice nuclei are clay minerals; however the technique did not eliminate many of the inert aerosols. M.G.J.

N65-33096 Chicago Univ., Ill. Cloud Physics Lab.

GLOBAL ASPECTS OF THE PRODUCTION AND DISTRIBUTION OF GIANT SEA-SALT PARTICLES

Yoshiaui Toba *In its* [Cloud Phys.] 1 Jun. 1965 13 p refs (See N65-33092 21-13)

In an approximate treatment, used to study the manner in which the giant sea-salt particles are distributed, the atmosphere is divided into two parts: These are: (1) the average vertical distribution in the atmosphere as a whole, where the characteristic feature is quantitatively explained by a combination of sedimentation, diffusion, convection processes, and coalescence in clouds, and (2) the vertical distribution in the 10-m layer over the sea surface, where it is assumed that a steady state holds with no horizontal gradient, and that each droplet instantaneously attains its equilibrium salinity for the vapor pressure and temperature of the air at any level. The most plausible rate of production of the particles on the sea surface are determined as a function of surface wind speed and the mass of salt in the particles. The average distribution of the particles at various levels over the world ocean is estimated by combining these results with marine climatic data. Equations are given, and the findings plotted. M.G.J.

N65-33105# Committee on Space Research (COSPAR), The Hague (Netherlands).

SOUNDING ROCKET RESEARCH TECHNIQUES

London, Intern. Quiet Sun Years Secretar., 1964 157 p refs IQSY Instruction Manual No. 9 CFSTI: HC $5.00/MF $1.00

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3. A GUIDE TO ROCKET LUMINOUS VAPOR TRAIL EXPERIMENTS M. Dubin p 42–73 refs (See N65-33108 21-13)

4. A MANUAL ON NIGHT AIRGLOW PHOTOMETRY D. M. Packer p 74–88 refs (See N65-33109 21-13)

5. A MANUAL ON MOLECULAR OXYGEN DETERMINATION FOR THE IQSY H. Friedman, T. A. Chubb, and J. M. Siomkajlo p 89–104 refs (See N65-33110 21-13)

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8. ELECTRON DENSITY MEASUREMENTS BY THE RADIO PROPAGATION TECHNIQUE S. A. Bowhill p 119–125 refs (See N65-33112 21-13)

9. LANGMUIR PROBES FOR MEASUREMENTS IN THE IONOSPHERE L. G. Smith p 126–136 refs (See N65-33113 21-13)

10. RESONANCE PROBE K. Hirao and T. Muraoka p 137–145 refs (See N65-33114 21-31)

11. STANDING WAVE IMPEDANCE PROBE J. C. Ulwick, W. Pfister, O. C. Haycock, and K. D. Baker p 145–152 refs (See N65-33115 21-31)

N65-33106 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE ROCKET-GRENADE EXPERIMENT

W. Nordberg and W. Smith *In* COSPAR Sounding Rocket Res. Tech. 1964 p 1–32 refs (See N65-33105 21-13) CFSTI: HC $5.00/MF $1.00

The operation and performance of a rocket-grenade experiment to measure wind velocities and temperatures and to derive densities and pressures by detonating explosive charges at predetermined height intervals during the ascent of a rocket to altitudes of approximately 90 km is presented. The sound energy from the explosions is recorded by a microphone array on the ground. The time and direction of the arriving sound waves are calculated. The rocket position is accurately determined by a combination of radar, Doppler velocity and position, and optical tracking systems. An analysis of these coordinates yields the direction and magnitude of the sound velocity vector in the layer between two explosions. This vector is a measure of the temperature and wind in the layer. R.N.A.

N65-33107 Committee on Space Research (COSPAR), The Hague (Netherlands).

A GUIDE TO THE LITERATURE ON THE FALLING SPHERE METHOD FOR MEASURING UPPER-AIR DENSITY, TEMPERATURE AND WIND

L. M. Jones, comp. *In its* Sounding Rocket Res. Tech. 1964 p 33–41 refs (See N65-33105 21-13) CFSTI: HC $5.00/MF $1.00

A selected annotated bibliography is presented on the falling sphere technique for measuring upper atmosphere density, temperature, and wind The documents were selected to emphasize technique rather than results and thus constitute a manual of how to perform aeronomical measurements with spheres. R.N.A.

N65-33108 Committee on Space Research (COSPAR), The Hague (Netherlands).

A GUIDE TO ROCKET LUMINOUS VAPOR TRAIL EXPERIMENTS

Maurice Dubin, comp. *In its* Sounding Rocket Res. Tech. 1964 p 42–73 refs (See N65-33105 21-13) CFSTI: HC $5.00/MF $1.00

The procedures for using sodium vapor as a trace element in rocket experiments to study upper atmosphere parameters are described. Sodium vaporizors, rocket instrumentation, cloud position determination by triangulation photography, data

reduction and analysis, and safety precautions are described. The rocket payload design and loading procedure for, and chemiluminescence of trimethyl aluminum, released at high altitudes to provide a photographable chemiluminous trail permitting wind motion observations, are described. Filter and film types used for discriminating various wavelengths in photographing scattered light from rocket released clouds of sodium, lithium, and potassium vapors are discussed. Developing techniques to insure the required contrast and photographic latitude are considered. Film calibration and processing for subsequent densitometry is described. Consideration is given to the changing background intensities during twilight, and to the optimum exposure under these various conditions. R.N.A.

N65-33109 Committee on Space Research (COSPAR), The Hague (Netherlands).
A MANUAL ON NIGHT AIRGLOW PHOTOMETRY
Donald M. Packer *In its* Sounding Rocket Res. Tech. 1964 p 74–88 refs (See N65-33105 21-13) CFSTI: HC $5.00/MF $1.00

Calibration procedures for night airglow photometry from rockets are presented. Rocket performance effects on photometry observations, methods of measuring the altitude variation of the airglow intensity, and rocket attitude determination are discussed. The calibration procedures involve measuring the relative spectral characteristics of all elements of the photometer, and measuring the sensitivity of the photometer in absolute units. Appendices are included on photometer calibration source and computation of source radiance. Spectrograms of the night airglow with identification of various spectral features are given. R.N.A.

N65-33110 Committee on Space Research (COSPAR), The Hague (Netherlands).
A MANUAL ON MOLECULAR OXYGEN DETERMINATION FOR THE IQSY
H. Friedman, T. A. Chubb, and J. M. Siomkajlo *In its* Sounding Rocket Res. Tech. 1964 p 89–104 refs (See N65-33105 21-13) CFSTI: HC $5.00/MF $1.00

A detailed description of the rocket instrumentation, an ultraviolet photoionization chamber, for measuring the vertical distribution of molecular oxygen in the upper atmosphere is presented. The mechanical specifications, construction and assembly, gas filling, electrical leakage specification, calibration, and electronics of the photoionization chamber are described. R.N.A.

N65-33111 Committee on Space Research (COSPAR), The Hague (Netherlands).
A MANUAL ON IONOSPHERIC CURRENT MEASUREMENTS
Laurence J. Cahill, Jr. *In its* Sounding Rocket Res. Tech. 1964 p 105–117 refs (See N65-33105 21-13) CFSTI: HC $5.00/MF $1.00

Discussions are presented on the ionospheric current systems as deduced from ground measurements, experimental procedures for studying the currents by rocket magnetometer, problems that are common to all rocket magnetometer experiments, and various magnetometer systems that are presently employed in such measurements. R.N.A.

N65-33112 Committee on Space Research (COSPAR), The Hague (Netherlands).
ELECTRON DENSITY MEASUREMENTS BY THE RADIO PROPAGATION TECHNIQUE
S. A. Bowhill *In its* Sounding Rocket Res. Tech. 1964 p 119–125 refs (See N65-33105 21-13) CFSTI: HC $5.00/MF $1.00

A list of proposed synoptic sounding rocket projects on electron density and temperature measurements are discussed. A radio propagation technique for measuring electron density is presented. The technique is based on the propagation of a radio wave between a rocket and a ground station. The amplitude and phase of the radio wave are measured and from these the electron density is deduced using the known relations for a wave propagating in a magneto-ionic medium. R.N.A.

N65-33113 Committee on Space Research (COSPAR), The Hague (Netherlands).
LANGMUIR PROBES FOR MEASUREMENTS IN THE IONOSPHERE
L. G. Smith *In its* Sounding Rocket Res. Tech. 1964 p 126–136 refs (See N65-33105 21-13) CFSTI: HC $5.00/MF $1.00

A simplified theory of the Langmuir probe, its fundamental limitations, and its application to rocket and satellite measurements of electron density and temperature in the ionosphere are described. The potential value of the probe in the D region is noted although the Langmuir theory is not strictly valid at such low altitudes due to the relatively high neutral gas density. The design and construction of an instrument for use in sounding rockets is given. This instrument alternates the normal Langmuir technique with a second mode which is more suitable for studies of sporadic E and other highly localized features of the electron density profile. The most significant deviation from Langmuir probe theory encountered concerns the actual value of the electron random current density. Observations indicate values lower than theoretical values by a factor approaching an order of magnitude. This discrepancy is believed to be caused by the effect of the earth's magnetic field. The measurement of electron temperature is independent of such factors as electrode geometry and the geomagnetic field. R.N.A.

N65-33131*# California Univ., Berkeley. Space Sciences Lab.
ENZYME ACTIVITY IN TERRESTRIAL SOIL IN RELATION TO EXPLORATION OF THE MARTIAN SURFACE Second Semiannual Progress Report
J. O. Falkinham, J. Skujins, and A. D. Mc Laren 20 Jul. 1965 63 p refs Submitted for Publication *Its* Ser. 6, Issue 30 (Grant NsG-704)
(NASA-CR-64628) CFSTI: HC $3.00/MF $0.75 CSCL 08D

The effects of the physical environment of soils on the soil biological processes are reviewed, with emphasis on the effects of limited water availability to microbial and encymatic activities. Dehydrogenase, phosphatase, and urease activities were determined in 24 different soils of interest in extraterrestrial life exploration. It was determined that the decrease of urease activity *versus* increased urea concentration appears to be a linear function, irrespective of other reactants present. Work is in progress to obtain data on urea stability and to determine the thermodynamic behavior of any urea decomposition products at elevated temperatures. Measurable dehydrogenase activity was only found in reasonable fresh soils. Phosphatase activity existed in all soils at their natural pH, except in gravelly desert, alkaline Hilgard soils, and the Pt. Barrow soil. Agitation of the samples during incubation increased the results of phosphatase activity about 10-fold. G.G.

N65-33151# Sandia Corp., Albuquerque, N. Mex.
MEASUREMENTS OF THE IONOSPHERE TEMPERATURE ON THE BASIS OF MOLECULAR FLUORESCENE INDUCED ARTIFICIALLY BY MEANS OF ROCKETS [MESURES DE TEMPERATURE DE L'IONOSPHERE A PARTIR DE LA FLUORESCENCE DE MOLECULES PRODUITES ARTIFICIELLEMENT AU MOYEN DE FUSEES]

B. Authier 12 May 1965 34 p refs Transl. into ENGLISH from Ann. Geophys. (Paris), v. 2, no. 4, Oct.–Dec. 1964 p 353–382
(SC-T-65-728)

Rotation temperature and vibration temperature equal to kinetic temperature of the atmosphere are measured from photometric and spectroscopic observations performed on molecular clouds ejected by rockets from 120 to 210 km of altitude. The experiments take place at twilight; the fluorescence is observed from the ground. The method and the choice of the molecules are defined from theoretical consideration. The photometry of the clouds demonstrates the feasibility of the temperature measurements, which are performed with 2 spectrographs. The rotation temperature is deduced from the P branch of the O–O band of the $A^2\Sigma^+$–$X^2\Sigma^+$ transition of A/O. At 120 km, $\theta°\,K = 200^{+100}$ and at 170 km $\theta°\,K = 730$ (±100). The vibration temperature is deduced from the relative intensity of bands heads of the $\Delta\nu = +1$ and $\Delta\nu = -170$ sequences of the same transition. At 170 km: $\theta°\,K = 170$ ±150, 210 km: $\theta°\,K = 1250 \pm 150$. Author

N65-33201# Joint Publications Research Service, Washington, D. C.
INTERPRETATION OF MAGNETIC AND GRAVITATIONAL ANOMALIES USING A "URAL-1" COMPUTER
V. P. Stepanov and D. G. Subkhankulova 15 Sep. 1965 11 p refs Transl. into ENGLISH from Razvedka i Okhrana Nedr (Moscow), no. 6, Jun. 1965 p 36–40
(JPRS-32003; TT-65-32497) CFSTI: $1.00

A URAL-1 computer was programmed to interpret magnetic and gravitational anomalies. The anomalies in the structure of the crystalline basement are localized by calculation. Higher derivatives of the magnetic and gravitational potential are then computed using differential Laplace equation solutions. Sample calculation equations and anomaly maps are included. W.M.R.

N65-33229# Wisconsin Univ., Madison.
DENSITY OF THE ATMOSPHERE ABOVE 120 KILOMETERS AS DERIVED FROM SATELLITE MEASUREMENTS
James Anthony Degiovanni (M.S. Thesis) 1965 65 p refs
(AD-617303)

Satellite measurements have indicated that there are large time variations in density at heights above 200 km. These variations have been correlated with the level of activity of the sun, magnetic storms, and position on the earth relative to the sub-solar point. This paper is a survey of the use of satellite drag perturbations to measure atmospheric density. It includes a discussion of three of the most important atmospheric models that have resulted from satellite measurements. An extensive bibliography is included. Author

N65-33232# Inter-Range Instrumentation Group, White Sands Missile Range, N. Mex.
METEOROLOGICAL ROCKET NETWORK FIRINGS. VOLUME XXV: SEPTEMBER 1963 FIRINGS Data Report
Dec. 1964 187 p
(IRIG-109-62, Vol. XXV; AD-462756)

The types of rockets and their temperature and wind sensor instrumentation systems are identified on charts and by code. Wind data were obtained from radar plotting grids through a graphical conversion of the sensor displacement during standard time increment into average velocity components. Altitudes were also obtained from the grids and represent the mean altitude for each time interval. The variable interval was introduced as a compensation for the fall-rate characteristics of the sensors. The wind profiles presented are made up by connecting each time interval computation and are not smoothed further. Temperature instrumentation, for measuring temperature directly, consisted of modified 1680 mc radiosonde transmitter units and bead thermistor sensors. R.W.H.

N65-33360*# Geophysics Corp. of America, Bedford, Mass.
TURBULENT DIFFUSION OF SODIUM VAPOR TRAILS IN THE UPPER ATMOSPHERE
Owen Coté Washington, NASA, Sep. 1965 75 p refs
(Contract NASw-1083)
(NASA-CR-301) CFSTI: HC $3.00/MF $0.75 CSCL 04A

Photographs of sodium vapor trails formed at twilight in the upper atmosphere were analyzed to determine their diffuse growth. In studying photographs of the dispersive light scattering clouds, it was found that insufficient attention to the details of image formation can lead to errors when interpreting image growth in terms of atmospheric turbulence. Below 110 km and over a time interval of 700 to 800 seconds, the most probable interpretation of the horizontal accelerated expansion of sodium clouds is the relative dispersion law, $\sigma^2 \sim t^2$, in which the rate of change of standard deviation is about 2 meters per sec. The variability in the evidence for accelerated cloud expansion suggests that a $\sigma^2 \sim t^3$ dispersion law is as likely a $\sigma^2 \sim t$ law. The determination of the true dispersion law representing sodium cloud expansion requires the separation of atmospheric dispersion effects from the non-dispersive optical effects on image growth. The results of cloud expansion at 108 to 109 km indicate that there is not a unique equivalence between the rate at which a cloud grows and its physical appearance, irregular, globular, or smooth. R.N.A.

N65-33363*# National Aeronautics and Space Administration, Washington, D. C.
NUMERICAL SOLUTION OF AN INTEGRAL EQUATION ON THE THEORY OF LIGHT SCATTERING IN THE ATMOSPHERE [REZUL'TATY CHISLENNOGO RESHENIYA INTEGRAL'NOGO URAVNENIYA TEORII RASSEYANIYA SVETA V ATMOSFERE]
Ye. S. Kuznetsov and B. V. Ovchinskiy Sep. 1965 102 p refs Transl. into ENGLISH from Tr. Geofiz. Inst. (USSR), no. 4, 1949 p 1–103
(NASA-TT-F-372) CFSTI: HC $4.00/MF $0.75 CSCL 04A

Individual papers by various authors discuss the results of computation of spherical scattering of light in the atmosphere by integral equations, with emphasis on tabulated data. Eight- and seven-place Tables are given for the $E_1(X)$ to $E_4(X)$ functions, based on various values of physical parameters such as optical thickness of the atmosphere, zenith distance of the sun, and albedo. Successive approximations, including the zero-th approximation, are derived and corrections for errors of quadrature with allowance for haze, diffusion, and reflection are given. Author

N65-33387# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
ICE BRIDGE ANALYSIS
Donald E. Nevel Apr. 1965 15 p refs
(CRREL-RR-148; AD-615736)

A technique for strengthening of the ice on naturally frozen rivers is to successively flood and freeze within a confined width, creating a much thicker "ice bridge." An exact analysis is made of the elastic deformation and the moments in the bridge for arbitrarily placed, concentrated and distributed loads. The results are given in terms of infinite convergent series, which may easily be evaluated numerically. For the case of the infinitely wide river, the solutions become integrals. Author

N65-33432# Joint Publications Research Service, Washington, D. C.
BACKSCATTER SOUNDING OF THE IONOSPHERE AT MURMANSK
G. P. Tsirs 16 Sep. 1965 17 p refs Transl. into ENGLISH from Issled. Polyarnykh Siyaniy, Geomagnitnykh Vozmushcheniy i Ionosfery v Vysokikh Shirotakh (Moscow), 1965 p 54–62
(JPRS-32042) CFSTI: $1.00

Several results of observations of backscatter sounding of the ionosphere at Murmansk are given and compared with vertical sounding data. The transmitter power, antennas, and receiving and recording device made it possible to observe backscattered echos with ground ranges of the order of 400 to 6000 km even in the presence of large perturbations of the ionosphere, for example in the absence of vertical sounding reflections at Murmansk. The use of vertical sounding data at the control points or at least at the initial point of the link may greatly facilitate the interpretation of the picture of the echo field in the presence of several reflecting layers. Under winter conditions of the ionosphere good agreement of the vertical sounding and backscatter data for the F2 layer was noted. Under summer conditions of the ionosphere the investigation of the role of the F2 and E_S layers on the given link requires more exact systematic observations and measurements of the angles of incidence and the intensity of the echo field. E.E.B.

N65-33453# Oklahoma Univ. Research Inst., Norman. Atmospheric Research Lab.
EXAMINING THE NATURE OF CONVECTIVE AND OROGRAPHIC CLOUD SYSTEMS USING SATELLITE CLOUD PHOTOGRAPHS Final Report, 1 Jun. 1964–31 May 1965
Yoshikazu Sasaki 31 May 1965 86 p refs
(Contract Cwb-10863)

A simple mathematical model is developed which concerns the formation of cellular cloud patterns found by the satellite photographic observation. Upward turbulent heat and momentum transports from the surface boundary layer to the upper boundary layer (subsidence inversion, for instance) through the fully turbulent layer play important roles in this model. The turbulent layer between the two boundary layers is filled with fully turbulent air where Rayleigh number and Reynolds number are believed to be of the order of 10^9 to 10^{12}. The conditions necessary to form the fully turbulent air into a flat cellular pattern are obtained by applying the small perturbation method. It is also shown in this paper, by applying the solution to a special case, that the wave length of maximum amplification is a function of depth and eddy coefficients of turbulent layer and static stability of the upper inversion layer, and that the rate of maximum amplification is only a linear function of upward heat flux from the surface boundary layer to the turbulent layer. Author

N65-33467# Lichtklimatisches Observatorium, Arosa Switzerland).
VERTICAL OZONE DISTRIBUTION OVER AROSA Final Report, Aug. 1963–Dec. 1964
Hans Ulrich Dütsch Mar. 1965 78 p refs Prepared jointly with Nat. Center for Atmospheric Res., Boulder, Colo.
(Grant AF-EOAR-62-115)
(AFCRL-65-419; AD-619251) CFSTI: HC $3.00/MF $0.75

Another set of Umkehr data (August 1963–December 1964) from the routine observations at Arosa was processed by using a newly developed evaluation technique and improved corrections for higher order scattering. The influences of these changes on the results were studied. Some interesting anomalies observed during this period as well as slow fluctuations of ozone concentration at different levels are discussed. An interesting long trend variation in the upper stratosphere which seems to follow the solar cycle is pointed out, demonstrating the need for continuation of such observations over an extended period. Author

N65-33484# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
ENGINEERING GEOLOGY OF BUCKBOARD MESA Interim Report
D. C. Banks and R. T. Saucier Jul. 1964 149 p refs
(PNE-5001P; AD-462139)

The data gathered on the physical properties of the basalt deposits in the Buckboard Mesa portion of the Nevada Test Site are presented. Geologic studies and field and laboratory investigations were conducted in this area, both before and after high explosive detonations, to assess the stability of the cratered slopes. Preliminary evaluation of the data was undertaken in the interest of selecting sites for future tests. The ultimate objective of this program is development of the capability for performing large scale excavations using nuclear explosives. J.M.D.

N65-33501*# Texas Univ., Austin. Dept. of Civil Engineering.
BEHAVIOR OF A SANDY CLAY UNDER VERTICAL IMPACT OF GEOMETRIC SHAPES
Arthur R. Poor, William R. Cox, and Lymon C. Reese May 1965 157 p refs
(Grant NsG-604)
(NASA-CR-64838) CFSTI: HC $5.00/MF $1.00 CSCL 08N

An experimental investigation was performed to define the soil response on three geometric shapes during impact. Two sizes of vehicles were utilized having plate, sphere and cone configurations with constant ratios of diameter, available surface contact area, and weight being maintained between each size. Impact velocity and mass were varied for each series of test vehicles. The acceleration-time history of the reactive soil forces on the impacting vehicle was recorded on an oscilloscope utilizing accelerometers as the sensing devices. Analysis was accomplished by computer program to obtain the magnitude of reactive force as a function of deformation. A modulus of deformation was determined as a constant for each geometric configuration. The magnitude of reactive force was a function of vehicle mass and impact velocity. Equations for the modulus of deformation and maximum reactive force were defined to permit prediction by extrapolation of the phenomenological behavior of larger vehicles. Author

N65-33502*# Stanford Univ., Calif. Radioscience Lab.
STUDIES OF THE TOPSIDE IONOSPHERE WITH THE ALOUETTE SATELLITE Technical Report No. 9
T. M. Watt Apr. 1965 102 p refs
(Grant NsG-30-60)
(NASA-CR-64839; SEL-65-046) CFSTI: HC $4.00/MF $0.75 CSCL 04A

Electron density profiles obtained from Alouette soundings were used as the basis for scale height profiles from which relative ion concentrations, electron temperatures, and ion temperatures were deduced. Results were obtained for dip latitudes between 50° N and 85° N, and altitudes from 500 to 800 km. The lower latitude nighttime data were interpreted in terms of a three constituent (O^+, He^+, H^+) diffusive equilibrium model with an (O^+)-(He^+,H^+) transition occurring at about 600 km in the summer and 500 km in the winter. It was shown that the transition level rises with increasing latitude, rises quickly at local sunrise, and descends more slowly at local sunset; daytime scale heights for summer and winter vary slightly with latitude, but nighttime scale heights have large latitudinal variations. It was concluded that simple analyses of scale heights, in which isothermal or constant-gradient temperatures

are assumed, can lead to serious errors in interpreting ion distributions. M.G.J.

N65-33507*# Graduate Research Center of the Southwest, Dallas, Tex. Earth and Planetary Sciences Lab.
INVESTIGATIONS OF THE NEUTRAL COMPOSITION OF THE UPPER ATMOSPHERE Final Report
W. B. Hanson and T. W. Flowerday [1965] 15 p refs
(Contract NASr-177)
(NASA-CR-64843) CFSTI: HC $1.00/MF $0.50 CSCL 04A

A Nike-Apache rocket designated 14.62 UA was launched at 15:43 EST on March 18, 1965, from Wallops Island, Virginia. The payload consisted of a Paul massenfilter with an electron gun ion source looking out the nose of the rocket and a magnetic spectrometer which examined ambient ions looking out the side of the rocket. Also included were a magnetic and a solar aspect sensor to provide vehicle orientation data throughout the flight. The rocket reached a peak altitude of 158 km, and during its free fall time, it had a spin rate of 5.94 cps and a precession period of 37 seconds. A power supply failure obscured the data except for a 25 second window near apogee. Both spectrometers functioned well during this period and, on the whole, reasonable agreement with previous work was achieved. Anomalously large signals were obtained at mass 14 in the neutral spectrometer and at mass 28^+ in the ion spectrometer. These anomalies are unexplained. Author

N65-33525# Weapons Research Establishment (Australia).
IONOSPHERIC DATA FOR AUGUST 1964 FROM WOOMERA, SOUTH AUSTRALIA Ionospheric Data Bulletin
Feb. 1965 28 p
(CPD-1964/8(W)) CFSTI: HC $2.00/MF $0.50

Tables of the hourly values of the customary ionospheric parameters are given for the station at Woomera for August 1964. Author

N65-33538*# New Hampshire Univ., Durham. Dept. of Physics.
THE UNIVERSITY OF NEW HAMPSHIRE MAGNETOMETER PAYLOAD
N. C. Maynard, P. E. Lavoie, and S. B. Marshall, III [1965] 63 p refs
(Contract NAS5-3043; Grant NsG-33-60)
(NASA-CR-64932; UNH-64-6) CFSTI: HC $3.00/MF $0.75 CSCL 04A

A rocket magnetometer experiment was designed to study the S_q current system and the equatorial electrojet. The magnetic field was measured with a nuclear free precession magnetometer, and electron density was monitored with a dc Langmuir probe. The Nike-Apache two-stage solid fuel rocket was chosen for the vehicle. It can reach an apogee of about 170 km with a sixty-pound payload, well above the expected range of the currents but not so high that the region of interest (90 to 150 km) is passed too quickly. Three supporting experiments are mentioned: a barometric pressure switch, a radiation chamber densitometer (measuring air pressure) for trajectory determination, and a magnetic aspect sensor for rocket aspect information. R.W.H.

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N65-32405 Union Carbide Nuclear Co., Oak Ridge, Tenn. Y-12 Plant.
STRAIN GAGE TEST TO DETERMINE STRESSES AT THE ROOT OF THE INTERNAL THREADS OF CLOSURE ON A THIRTY-INCH PRESSURE VESSEL
P. J. Ross and W. D. Long *In its* Compendium of Gas Autoclave Eng. Studies 23 Aug. 1965 p 185-200 (See N65-32400 21-15) CFSTI: $6.00

The use of very small strain gages for determination of strain in the thread root areas of a thirty-inch pressure vessel was justified experimentally. The technique involves metal film gages, having a gage length of 50 mils and a width of 44 mils, which are secured in the root of the threads with cement. A wire small enough to fit in the annular clearance between the male and female closure threads leads to the gage. Conventional readout instrumentation is used. Results of tests under actual load conditions indicate that reliable information can be obtained if the installation of the gage and lead wire is done with exactness. J.M.D.

N65-32418* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
BIMAT FILM PROCESSING FOR RANGER IX
F. C. Billingsley *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 38-40 (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

A diffusion transfer process which produces simultaneously a positive and negative was investigated. The processing procedure consists of placing an imbibed bimat film in intimate contact with the exposed negative material for a suitable length of time to allow the chemical reactions to go to completion. The materials are then separated and each one washed and dried in the normal manner. The bimat film contains the processing chemicals and is damp and slippery to the touch but contains no free liquids. Because of the absence of free liquid to fill voids, the laminating process is quite critical. It was found that both the negative and the bimat require much less than the normal amount of washing. It was also found that the bimat material takes three times as long to dry as does the film. With proper lamination no difficulty was encountered due to run-out, air bubbles, etc. Short lengths of up to three feet may be laminated with a roller upon a table top. Lengths longer than this should be laminated in a processor. The process is quite satisfactory and enables the production of a negative in less time than could be accomplished by wet processing and in addition produces a high-quality positive simultaneously. E.E.B.

N65-32435* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A RASTER GENERATOR FOR USE IN THE MEASUREMENT OF SHOCK VELOCITIES
A. P. Horne *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 113-116 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

Limitations of the previously used raster generator are discussed and a new raster and associated equipment are described. A complete solid-state raster generator, including a wideband deflection amplifier, was built on a blank chassis plug-in unit for a type BM561A oscilloscope. No modifications to the oscilloscope were necessary because all waveforms needed to produce a complete raster presentation are generated by the new unit. The output amplifier has a bandwidth of 10Mc. This allows a triangle waveform with a period of only 10 μsec to be used without introducing turn around or phase shift distortion, thus providing a factor-of-five increase in resolution of the time base. Five sweep rates are provided derived from crystal controlled oscillators with a stability of ±0.003% over the temperature range of 20° to 60° C. The feedback networks and

crystals are switched to allow the use of one oscillator instead of one crystal oscillator and a series of frequency dividers. E.E.B.

N65-32437* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SOME CHARACTERISTICS OF A MINIATURE STRESS TRANSDUCER
A. San Miguel and R. H. Silver *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 126–131 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

The characteristics of a miniature stress transducer developed to measure the internal stress fields in solid propellants are discussed. The inclusion problem, packaging function, and temperature interactions are considered. The inclusion problem consists of determining the disturbing influence of a relatively rigid particle in an otherwise continuous stress field. The importance of the inclusion problem centers around the crack initiation phenomena. One objective of packaging is to protect the splinter from directly applied environmental loading. A second objective of the packaging is to limit the dimensional changes of the silicon splinter thereby greatly increasing the range of stress which may be applied to the element without fracturing it. A third objective of packaging is to provide an electrical contact as well as an application flexibility for bracing and recording wires. The equation for the response of one transducer and the equations for the evaluation of the three principal stresses within a point region of propellant are given. E.E.B.

N65-32444* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ULTIMATE SENSITIVITY OF IMAGING DEVICES
L. R. Malling *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 176–181 (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

The ultimate resolution of an imaging system is determined from the sine-wave response and the noise-power per unit bandwidth. For space photography, the minimum acceptable picture quality is taken as peak signal per rms noise or signal-to-noise ratio of ten. The photon population for a given luminous intensity was estimated by means of two separate concepts of the lumen. A useful approximation for space science is 1 ft-candle equals 1.1×10^{16} photons/sec. From the photon concentration on the picture element, the ultimate sensitivity may be expressed as $(n_s/B)^{1/2}$ for nonstorage devices and $(2n_s)^{1/2}$ for storage devices. The quantum efficiency of the slow-scan vidicon is shown to be much greater than is generally supposed and approaches that of the best photoconductive cells. As with the broadcast vidicon, early experimental samples exhibited a sensitivity that later units could only marginally exceed because of the fundamental relationship established by camera system restraints. E.E.B.

N65-32523 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MEASUREMENT OF PRESSURE OF HIGH-PRESSURE PULSE STREAMS BY THE TENSOMETRIC METHOD
V. P. Borodin, B. V. Voitsekhovskiy, and V. V. Mikhaylov *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 162–170 refs (See N65-32506 21-25)

Tensiometric testing was used for evaluating the performance of a transducer used to measure dynamic pressure on the order of tens of thousands of atmospheres. A description of the transducer, which is made in the form of a pitot tube in conjunction with a cylindrical tensiometer, is given. The transducer is simply made, is reliable, and is practically inertialess. During the first stage of tests, the phenomenon of stream self-cutoff was observed. This was removed by ejecting water through holes drilled along the entire circumference of the wall. Oscillograms of stream pressure taken by the transducer are given, and the data indicate that very high dynamic pressures can be successfully measured by the tensiometric method. L.S.

N65-32689# Cincinnati Univ., Ohio.
FEASIBILITY STUDY OF TWO NULLING PRESSURE MEASURING SYSTEMS Interim Technical Report, Feb.–Jul. 1963
David L. Brown Wright-Patterson AFB, Ohio, ARL, May 1965 66 p refs
(Contract AF 33(616)-8453)
(ARL-65-94; AD-618072)

The purpose of this study was to investigate the feasibility of developing a pressure measuring system which operated on a nulling principle with nulling capabilities of 0.01 mm Hg. An additional specification employed was that the entire system be small enough to fit in a wind tunnel model or model support system in order to reduce the time-lag. Two systems were investigated. The first used a known pressure as the nulling medium and the second system utilized an electrostatic pressure for this purpose. A working model of the first system was developed and tested. However, attempts to develop a working model utilizing the latter principle were unsuccessful. Author

N65-32700# Maurer (J. A.), Inc., Long Island, N. Y.
DEVELOPMENT OF A HIGH-ACCURACY PASSIVE V/H SENSOR Final Report, Jun. 1961–Feb. 1963
C. Lonn and E. Goldberg Wright-Patterson AFB, Ohio, AF Avionics Lab., Jan. 1964 133 p
(Contract AF 33(616)-8482)
(ASD-TDR-63-791; AD-348486) (Declassified)

Previous methods of determining V/H (velocity to altitude) ratio have produced accuracies of 95% or less. However, advanced aerial camera systems require significantly higher accuracies than this if they are to realize their full photographic potential. A new technique for determining V/H ratio has been developed. Extensive tests of a flyable breadboard model of this V/H sensor have shown it to yield V/H accuracies far better than any previous method. The device, which employs an optical motion sensor, permits these accuracies over a V/H ratio range of 30:1 and a terrain brightness range of 4000:1. The system automatically senses the actual V/H rate and actuates a decelerater as required to reach the proper value without presetting of controls. In addition, the system produces drift angle signals accurate to within ±15 minutes of arc. The accuracy and versatility of the V/H sensor offer a significant contribution to increased resolving power in aerial and space photography. Author

N65-32776# Suffield Experimental Station, Ralston (Alberta).
STUDIES ON SHOCK WAVES PRESSURE-TIME GAUGES. II: FURTHER INVESTIGATION OF GAUGE PROPERITIES
W. J. Fenrick and J. C. Muirhead 5 Feb. 1964 19 p refs (Suffield-TN-133) CFSTI: HC $1.00/MF $0.50

This note gives further results of studies on shock wave pressure-time gauges. Included is information on the spontaneous charge release effect which was observed following heat cycling of ceramic element gauges. In addition, the variation in output with temperature of quartz element gauges is discussed. Author

N65-32777# Suffield Experimental Station, Ralston (Alberta).
STUDIES ON SHOCK WAVE PRESSURE-TIME GAUGES. IV: ON SPONTANEOUS CHARGE RELEASE, LINEARITY AND TESTING FOR THERMAL RESPONSE

J. C. Muirhead and W. J. Fenrick 11 Mar. 1964 20 p refs (Suffield-TN-139) CFSTI: HC $1.00/MF $0.50

This note presents more observations on the spontaneous charge release effect in lead titanate-zirconate element gauges. It is shown that the magnitude of the effect is a function of applied voltage, and the time during which this voltage is applied. The presence of the effect in two types of commercial gauge is also noted. Results are given of tests conducted to assess the linearity of the charge/psi output of lead titanate-zirconate element gauges. It is shown that gauge output is more nearly linear when the charges, which are generated by subjecting the gauges to pressure pulses, remain on the elements, than is the case when the charges are allowed to leak off. Two procedures are described for testing the response of gauges to thermal effects. In the first, the radiant output from a flash bulb is used to simulate the radiant output from a TNT explosion. In the other, immersion of the gauges in boiling water simulates their immersion in the shock-heated air. Results of tests on a selection of gauges is given. It was observed that of the gauges tested, the "H3" quartz-element gauge is markedly superior in its resistance to thermal effects. Author

N65-32778# Emerson Electric Co., St. Louis, Mo. Electronics and Space Div.

SYSTEM PARAMETER MEASUREMENT USING TRANSIENT RESPONSE SAMPLING

R. Myers and J. Chorzel 4 Apr. 1964 32 p refs (Rept.-1717)

It is the purpose of this report to present a method for measuring system parameter variation by transient response analysis. This technique consists of sampling the transient response of an n parameter system at n points in time to form a set of simultaneous equations. The solution of these equations provides each parameter variation. A solution is possible when the partial derivatives of the transfer function are linearly independent with respect to the various parameters. A pulse type disturbance is applied to the system to obtain the response transient. Experimental results for several simple linear systems show that system parameters can be accurately measured with this technique using relatively simple instrumentation. Author

N65-32849# Union Carbide Nuclear Co., Paducah, Ky. Paducah Gaseous Diffusion Plant.

A CHROMATOGRAPH FOR THE ANALYSIS OF HIGHLY REACTIVE AND CORROSIVE COMPOUNDS

E. L. Williamson, C. M. Johnson, T. J. Mayo, and W. R. Rossmassler 8 Jul. 1965 23 p refs (Contract W-7405-ENG-26) (KY-485) CFSTI: $1.00

A chromatograph for the analysis of corrosive gases was designed, built, and tested. The instrument features a unique sample valve and a bleed to the carrier system to improve the analysis for hydrofluoric acid. Data on several individual and mixed gases are tabulated. Author

N65-32857# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

UNIVERSAL X-RAY GONIOMETER FOR ORIENTATION OF SINGLE CRYSTALS [UNIVERSAL'NYI RENTGENOVSKII GONIOMETR DLYA ORIENTIROVKI MONOKRISTALLOV]

S. Bednarski, K. Skoczek, and S. Sharras Dec. 1964 10 p ref In RUSSIAN; ENGLISH summary (Rept.-587/II) CFSTI: HC $1.00/MF $0.50

An X-ray goniometer for orientation of single crystals by means of the back reflection Laue method is described. Using the goniometer, it is possible to study almost every point of the surface of a very long single crystal without moving the sample in the holder. The goniometer is designed for the X-ray study of very large single crystals. Sufficiently large shifts as well as interchangeable holders make it possible to study small samples several millimeters in size. R.N.A.

N65-32878*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

EFFECT OF ELECTRON RADIATION ON TV LENS COMPONENTS

Lawrence Kobren Sep. 1965 10 p refs (NASA-TN-D-2919) CFSTI: HC $1.00/MF $0.50 CSCL 14E

Optical glasses similar to those which will be used as lens materials in the TV camera system of the Nimbus satellite were exposed to 1- and 2-Mev electrons to determine the effect of electron bombardment on their optical properties. The electron flux used was 4.5×10^{11} electrons/cm^2-day which approximates the orbital environment of the satellite. Results indicated a significant reduction in the optical transmissivity of the glasses during exposure. However, it was found that damage to the glass could be significantly reduced with the use of a protective coverplate made from radiation resistant fused silica. Author

N65-32921# Sandia Corp., Albuquerque, N. Mex.

DEVELOPMENT OF TWO PURE FLUID TIMERS

G. V. Lemmon and E. R. Phillips Oct. 1964 13 p (Contract AT(29-1)-789) (SC-R-64-180; CONF-814-1)

The development of two pure fluid timer prototypes is described. A prototype of timer No. 1 was successfully demonstrated, modified and expanded to produce prototype No. 2. Details of this prototype are emphasized. The logic of prototype No. 1 is very similar except no variable selection of times is provided and all decoding is done in a straight binary fashion. The clock, counter circuit, decoding section, output memory, and selector switch are discussed. The prototype of timer No. 2 contains 100 identical NOR gates (a NOR gate is defined as an inverter driven by an OR gate, in this case a 4-input OR gate) plus one monostable toggle device in the clock. Timer No. 1 contained 84 NOR gates plus the clock. Both timers worked immediately upon assembly, except for one minor logic error in the first, and required no timing or adjustments of any kind. This demonstrates that with a truly reliable element having adequate fan-in and fan-out characteristics, very complex logic networks can be designed and built with ease using pure fluid devices. The elements used in the timers were produced by a casting technique and were 100% tested before assembly. R.N.A.

N65-32986# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.

POSITIVE MAGNETOMETER FOR NUCLEAR MAGNETIC RESONANCE [MAGNETOMETRE ABSOLU A RESONANCE MAGNETIQUE NUCLEAIRE]

Antoine Salvi (Ph.D. Thesis—Grenoble Univ.) 1964 49 p refs In FRENCH (CEA-R-2383) CFSTI: HC $2.00/MF $0.50

The measurement of nuclear magnetic resonance is considered. Three types of magnetometers are briefly described and evaluated, including the Varian Packard device, the Abragam-Solomon-Combrisson oscillating maser apparatus, and an oscillating circuit frequency measuring system. The circuit

diagrams and operational procedure of an auto-oscillating magnetometer capable of providing absolute measurement of the nuclear magnetic resonance of the earth's field are presented. Frequency measurements taken with the device, and resonance calculations are included. Transl. by G.A.L.

N65-33044# Royal Aircraft Establishment, Farnborough (England).
A SATELLITE PLANISPHERE [SPUTNIKOVAYA PLANISFERA]
R. Janichek Jun. 1965 13 p Transl. into ENGLISH from Byul. St. Optich. Nablyudeniya Iskusstv. Sputikov Zemli (USSR), no. 36, 1963 p 8–13
(RAE-LIB-TRANS-111) CFSTI: HC $1.00/MF $0.50

A description is given as well as the theory of an instrument which makes it possible from the known orbital elements of an earth satellite to define very simply the visible topocentric trajectory of a satellite on the celestial sphere, as well as by comparison with observations to refine the orbital elements. This instrument consists of a chart of the heavens and transparent films with the corresponding nets plotted on them.
Author

N65-33100# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INSTRUMENTS AND EXPERIMENTAL TECHNIQUES (SELECTED ARTICLES)
30 Jun. 1965 22 p refs Transl. into ENGLISH from Pribory i Tekhn. Eksperim. (USSR), no. 1, 1964 p 121–123, 183–186, 197–198
(FTD-TT-65-320/1+2+4; AD-617908)

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N65-33101 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SUPPRESSION OF NOISE WHEN OBSERVING A NUCLEAR MAGNETIC RESONANCE SIGNAL OF A MAGNETIC FIELD MEASURER
G. S. Anufriev, O. F. Afonin, and B. A. Mamyrin *In its* Instr. and Exptl. Tech., 30 Jun. 1965 p 1–5 refs (See N65-33100 21-14)

Described are parameters of a system for stroboscopic transformation of a signal of nuclear-magnetic resonance of an IMI-2 magnetic field measuring device. The system allows to improve the signal/noise ratio by 5–50 times. Author

N65-33102 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AUTOMATIC CALCULATION OF DISLOCATIONS
A. L. Sobolev and Yu. V. Sokurenko *In its* Instr. and Exptl. Tech., 30 Jun. 1965 p 6–13 refs (See N65-33100 21-14)

Discussed are methods of calculating dislocations in germanium and silicon samples and a description is given of the block-diagram of a TV automatic counter, manufactured on the basis of industrial TV installation PTU–OMI. Author

N65-33103 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINING THE COMPOSITION OF FILLING A DIFFUSION CHAMBER IN ITS SENSITIVE LAYER
L. V. Bakanov, A. P. Grayevskiy, V. D. Lebedev, and M. V. Stabnikov *In its* Instr. and Exptl. Tech., 30 Jun. 1965 p 13–16 refs (See N65-33100 21-14)

In the sensitive layer of a diffusion chamber there is an unavoidable admixture of molecules of the working liquid, ordinarily methyl alcohol. To evaluate cases of nuclear radiation passing through the chamber and reacting with nuclei of the admixture, it is necessary to know the absolute content of methyl alcohol in the sensitive layer of the gas filling the chamber at various pressures. Such measurements were made previously at a pressure in the chamber equal to atmospheric. Results are reported of measuring the alcohol content of the gas filling the chamber at a pressure of 1 and 2 atm. The method of taking a control sample was employed because it allows a sufficiently reliable determination of the content of the working liquid in the form of vapor and droplets. N.A.S.

N65-33132*# Raymond Engineering Lab., Inc., Middletown, Conn.
MODEL 1738 TAPE RECORDER/REPRODUCER. GENERAL TEST REQUIREMENTS
D. S. Grosso 16 Jun. 1964 195 p Prepared for JPL Revised (Contracts NAS7-100; JPL-950105)
(NASA-CR-64830) CFSTI: MF $5.00/MF $1.25 CSCL 14C

A formal acceptance procedure for the Model 1738 recorder/producer is presented. Functional tests and operational data are defined for each of its five subassemblies, to insure system compatibility and evaluation sequence of the completed assembly. Supporting equipment to simulate commands and data signals originating from other parts of the spacecraft are contained in a rack. The control panel of the rack is shown in a diagram. G.G.

N65-33140*# Autonetics, Anaheim, Calif.
EVALUATION OF STAR GYRO TORQUING Final Report
W. H. Quick and W. C. Wey 15 Jul. 1965 156 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950889)
(NASA-CR-64615; C5-1277/32) CFSTI: HC $5.00/MF $1.00 CSCL 17C

Research conducted under a study designed to: (1) develop the theory of STAR gyro torquing in sufficient detail to permit the accurate prediction of torquing scale factors for any future instrument design, and to determine the effect of all important error sources; (2) experimentally demonstrate the feasibility of torquing at rates from 0 to 2000 degrees per hour; and (3) make measurements to provide data sufficiently accurate to be used for checking the theoretical results being developed; is reported. The specific program goal of showing torquing feasibility for rates up to 2000 degrees per hour was achieved electrostatically. Experimental data served to substantiate the derived theoretical expressions. Results indicate that there is no fundamental or practical limitation in the precision torquing of the STAR gyro, and that the most preferable means of torquing appears to be electrostatic. S.C.W.

N65-33177*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TWO-COMPONENT MICROBALANCE FOR MEASURING THE FORCES ON ION-BOMBARDED SURFACES

Vernon L. Rogallo and Howard F. Savage [1965] 14 p refs
(NASA-TM-X-56772) CFSTI: HC $1.00/MF $0.50 CSCL 14B

A two-component null-type microbalance has been developed to measure forces due to ion bombardment on a surface. The balance employs the principle of the attracted disk electrometer. The sensitivity can be adjusted by simply changing the location of the center of gravity. Measurements of a few micrograms of force in two perpendicular directions can be made simultaneously. Author

N65-33202# Joint Publications Research Service, Washington, D. C.
SEMIAUTOMATIC APPARATUS FOR PROCESSING AEROGEOPHYSICAL DIAGRAMS
N. S. Blat, V. S. Tsirel', and G. S. Frantov 15 Sep. 1965 11 p Transl. into ENGLISH from Razvedka i Okhrava Nedr (Moscow), no. 6, Jun. 1965 p 40–45
(JPRS-32004; TT-65-32498) CFSTI: $1.00

The Russian apparatus for processing aerogeophysical diagrams consists of a computer unit, paper movement and scale mechanisms, mechanisms for the determination of unfixed coordinates and the recording of a secondary diagram, plus a current source, control panel, and electric motor. The instrument reportedly can ensure a time saving by a factor of four while maintaining accuracy and continuity of recording. It could be used for processing aerial magnetograms and aerial electrograms to develop field maps for preliminary interpretation. W.M.R.

N65-33250*# Engineering-Physics Co., Rockville, Md.
INDUCTION FLOWMETER FOR DIELECTRIC FLUIDS, EXPERIMENTAL VERIFICATION Final Report
Vincent Cushing, Dean Reily, and T. R. Schein 16 Apr. 1962 49 p refs
(Contract NASr-53)
(NASA-CR-64640) CFSTI: HC $2.00/MF $0.50 CSCL 14B

Experimental verification is given for an induction flowmeter for use with dielectric fluids. Its two unique, advantageous characteristics are obstructionless flow passage and no moving parts. A discussion is presented in general terms and indicates the theoretical expectations as compared with the observed performance. Areas considered are the equivalent circuit, frequency of operation, input equivalent noise, coarse hum compensation, noise in flowing dielectric, and expected and measured voltages. A detailed discussion is given for the flowmeter components which include housing and fittings, magnetic circuit, pipe/transducer, amplifier, hum compensator, and associated electronic equipment. Schematics and graphs are included for these components. C.T.C.

N65-33272# United Kingdom Atomic Energy Authority, Harwell (England). Electronics Div.
REPORT ON DEVELOPMENTS IN HEALTH PHYSICS INSTRUMENTS IN ELECTRONICS DIVISION, A.E.R.E.
W. Abson and W. R. Loosemore, comp. and ed. 1965 73 p refs
(AERE-R-4552) CFSTI: HC $3.00/MF $0.75

Research and development relating to radiological protection and health physics instrumentation are reviewed under the general headings of external beta–gamma, neutron, surface contamination, and radioactive air particulates monitoring instruments; beta–gamma dose and dose-rate instruments; and gamma spectrometers. Also considered are measurement of gaseous and low level alpha activity; plug-in circuit boards; a portable criticality incident warning system; and semiconductor radiation devices. M.W.R.

N65-33311# Rome Air Development Center, Griffiss AFB, N. Y.
RATIONALE FOR AN AIR FORCE STANDARD UNIT RECORD FORMAT
John G. Santoro May 1965 116 p
(RADC-TR-65-99; AD-467391)

The importance of the type format of photos, maps, charts, and other graphic data involved in photo intelligence systems is discussed in terms of their effect on the manipulative processes and photo intelligence analysis functions. The varied functions promulgate a myriad of defining parameters. These parameters must be weighted as to their degree of importance in an attempt to select a format which will maximize the functions of the photo intelligence system. In light of the multitude of formats available and as a result of the qualities of each, it was concluded that a unit record of 70mm × 100mm prepared from roll film could most effectively satisfy the wide range of photo data reduction and storage and retrieval functions. The image area available on the standard unit record format would be 58mm wide × 58mm and up to 84mm long. The design criteria and a description of the standard unit record format is defined herein. Author

N65-33314# Aberdeen Proving Ground, Md. Ballistic Research Labs.
THE APPLICATION OF AN OPERATIONAL AMPLIFIER TO THE USE OF PIEZOELECTRIC TRANSDUCERS
Robert D. Wilson Apr. 1965 24 p
(BRL-MR-1646; AD-468282)

The purpose of this report is to discuss and to illustrate how the application of an operational amplifier in a recording system using piezoelectric transducers and long coaxial cable lengths overcomes the problem of low signal due to cable attenuation. Author

N65-33372# Army Missile Command, Huntsville, Ala. Instrumentation Branch.
AMRAD INSTRUMENTATION Final Measuring Report
James E. Tillery 15 Apr. 1965 39 p refs
(ARPA Order 198; Proj. Defender)
(RG-TR-65-10; AD-469035)

This report describes the transducer design and test work performed for the AMRAD instrumentation system. Measurements of deceleration, accaleration, temperature, pitch and yaw attitude, and roll position are shown. Error analyses are included but most of the component test results are omitted. These error analyses were based on Redbird booster trajectory information. However, use of the Athena booster would cause little change in the attitude and roll position measurement error analysis. An interstage instrumentation proposal, submitted just prior to cancellation of the AMRAD program, is included in Section V. Author

N65-33467# Massachusetts Inst. of Tech., Cambridge.
PRESSURE PROBE AND SYSTEM FOR MEASURING LARGE BLAST WAVES
J. Ray Ruetenik and S. Dean Lewis Wright-Patterson AFB, AF Flight Dyn. Lab., Jun. 1965 45 p refs
(Contract AF 33(616)-8499)
(ASRL-TR-105-2; AFFDL-TDR-65-35; AD-467828)

A new pancake-type pressure probe was developed for the measurement of blast pressure waves during the BIG SEA sled tests. This probe employs transducers of the type selected for wing pressure measurements in that program. It was evaluated in the shock tube under a range of flow Mach numbers encountered during the test. From these shock tube tests, a probe

form calibration was determined. Application of this type of probe to the BIG SEA tests is also described, including the mounting system, transducer and electronic calibration, and one blast wave record derived from this type of probe is presented. The results of the shock-overpressure measurements are compared with other test data. The pancake probe has a diameter of 4 inches and a thickness of 0.5 inch. The accuracy of measurement has been determined to be 3–5% of the shock overpressure for blast waves where the positive duration is 10 milliseconds or greater. The response time has been found to be less than 0.7 milliseconds. Author

N65-33473# Technical Operations Research, Burlington, Mass.
MODIFICATION OF THE TECH/OPS PHOTOMETRIC MEASUREMENT ASSEMBLIES Final Report, 4 Jan.–3 May 1965
I. L. Kofsky, C. S. Miller, A. J. Theriault, and R. H. Johnson Jun. 1965 37 p refs
(Contract AF 19(628)-4962)
(AFCRL-65-413; AD-619177)

Four photometric assemblies, consisting of photometers, radiometers, and radiometrically calibrated cameras, have been modified. The twelve-channel photometer has been improved by the addition of two filters for measuring the irradiance in ultraviolet N_2 second positive bands. The near-infrared photometer was fitted with a six-position interference filter wheel to permit observation of some of the N_2 first positive bands and OI permitted lines; in addition, its S-1 surface photomultiplier was enclosed in a thermoelectric refrigerator. The infrared radiometer now has a four-position filter wheel, and the temperature of its PbS photoconductive cell is monitored by a thermistor thermometer. De Havilland Mark 7A 35-mm data-recording cameras (with 100-ft magazines and flexible shutter programing) fitted with lenses having 108° circular fields replace the Nikon cameras and 77° lenses formerly used. All equipment has been made compatible with the mechanical mounts, windows, electrical power, and data-recording arrangements of the two Air Force KC-135 aircraft in which it will eventually be used. Author

N65-33516# Geophysics Corp. of America, Bedford, Mass.
ELECTRON/ION DENSITY INSTRUMENT PACKAGES FOR HIGH ALTITUDE GUN PROBES Tenth Monthly Letter Progress Report
12 Oct. 1964 4 p
(Contract DA-19-020-AMC-00292)
(AD-461066)

Acceleration tests of dc and ac probes are reported. Two ramp generator circuits were tested and two dc amplifier circuits and an ac amplifier were tested at 52 000 g acceleration. Both dc amplifiers survived the testing with no malfunction. The ac amplifier failed the test at 52 000 g after having passed the 42 000 g acceleration test. One of the ramp generators failed to survive the second peak acceleration test at 52 000 g after having survived the 42 000 g test. It is estimated that the failure is due to one of three 2 microfarad capacitors in each of the ramp generator circuits. Also, twelve units of transistor type MU970 were tested and survived three high acceleration tests without failure of any components. Further, twelve units of capacitors type TTC180 successfully survived testing. These two components are the key items of the ramp generator circuit. Two battery pack types survived three separate high acceleration tests. E.E.B.

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N65-32400# Union Carbide Nuclear Co., Oak Ridge, Tenn. Y-12 Plant.
COMPENDIUM OF GAS AUTOCLAVE ENGINEERING STUDIES
C. E. Muzzall, ed. 23 Aug. 1965 236 p refs
(Contract W-7405-ENG-26)
(Y-1478) CFSTI: $6.00

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N65-32401 Union Carbide Nuclear Co., Oak Ridge, Tenn. Y-12 Plant.
HAZARDS PERTAINING TO THE CONVERTED THIRTY-INCH PRESSURE VESSEL
Walker T. Smith *In its* Compendium of Gas Autoclave Eng. Studies 23 Aug. 1965 p 13–54 refs (See N65-32400 21-15) CFSTI: $6.00

This report covers a study of the hazards involved in operating a pressure vessel after convernsion to gas operation. A determination of the energy which would be released in case of vessel failure and the effect it would have on the surroundings has been made. It has been shown that the maximum energy release by the system is in the range of that released by a 40 to 50-pound TNT explosion, and that the containment cell walls are conservatively rated for personnel protection from incidents in the same range of energies. Author

N65-32404 Union Carbide Nuclear Co., Oak Ridge, Tenn. Y-12 Plant.
MECHANICAL DESIGN CRITERIA AND ANALYSES FOR CONVERTING PV-2 TO A GAS AUTOCLAVE
H. A. Pohto and C. D. St. Onge *In its* Compendium of Gas Autoclave Eng. Studies 23 Aug. 1965 p 133–183 refs (See N65-32400 21-15) CFSTI: $6.00

For conversion of a particular pressure vessel into a gas autoclave facility, the mechanical design modification criteria and analyses are presented. The facility is to have a relatively large capacity for processing materials at high pressures and elevated temperatures. J.M.D.

N65-32408 Union Carbide Nuclear Co., Oak Ridge, Tenn. Y-12 Plant.
GAS AUTOCLAVE FACILITY DESIGN LIMITATIONS
C. E. Muzzall *In its* Compendium of Gas Autoclave Eng. Studies 23 Aug. 1965 p 239–252 (See N65-32400 21-15) CFSTI: $6.00

Based on present state-of-the-art capability, the practical gas autoclave has limiting parameters of temperature, pressure, size, pressure fluid, and furnace design. The actual parameters selected for the system have been determined, and a general facility and process flow planned. Author

N65-32409 Union Carbide Nuclear Co., Oak Ridge, Tenn. Y-12 Plant.
SAFETY ANALYSIS FOR THE GAS AUTOCLAVE FACILITY
C. E. Muzzall *In its* Compendium of Gas Autoclave Eng. Studies 23 Aug. 1965 p 253–284 refs (See N65-32400 21-15) CFSTI: $6.00

A study has been made of the optimum pressure vessel design based on an analysis of modes of failure. From this, the magnitude and effects of energy release from expanding gas in the event of vessel rupture were calculated, and barricade design for this facility was predicated on shock-wave physics and blast-resistance theory. Author

N65-32424* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SEMICONDUCTOR RESEARCH
S. Denda and M-A. Nicolet *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 57–65 (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

Information on the preparation of n-m structures as required in studies of space-charge-limited current of electrons in silicon is presented. Diffusion techniques are discussed and experimental procedures are described. Also, the metallographic observation of the diffused layer; determination of the impurity concentration at the surface; voltage-current characteristics; and junction capacitance are considered. Further, the problems of electrical contacts to the diffused layer are included. E.E.B.

N65-32438* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
O-RING-ALKALI METAL COMPATIBILITY
W. Phillips *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 132–133 (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

A series of eleven O-ring materials were exposed to static potassium at 300° F for 500 hours. Buna N was the only material which retained its initial shiny, smooth, and elastic properties. Polyacrylic, butyl, silicone, fluoro silicone, natural rubber, and nitrile O-rings remained in fairly good condition. Neoprene was attacked and acrylate was completely destroyed. Teflon and Buna S were hardened and roughened, respectively. An identical series of rings were exposed to solid lithium at the same temperature. Buna N, acrylic, Buna S, neoprene, and nitrile were hardened and attacked. The silicone rubber ring was completely destroyed and not recovered. The butyl ring was softened to a plastic unuseable state. Polyacrylate, natural rubber, Teflon, and fluoro silicone appeared to remain in satisfactory condition. E.E.B.

N65-32446* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A DEVICE FOR MEASURING THE STATIC FRICTION (STICTION) BETWEEN MAGNETIC TAPE AND HEADS
W. G. Clement *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 187–191 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

A suitable test rig for determining the static-friction characteristics of various tapes and head materials was developed. With some refinements in procedure, it is anticipated that measurements will be repeatable within 20%. Some of the more interesting test data obtained are given which indicate the apparent desirability of monel and/or brass for head-bracket material as opposed to inconel, manganese-bronze, aluminum-bronze, or 310 stainless steel. E.E.B.

15

N65-32549*# California Univ., Berkeley. Space Sciences Lab.
INVESTIGATION OF KILOVOLT ION SPUTTERING Quarterly Progress Report
Harold P. Smith, Jr., F. C. Hurlbut, and T. H. Pigford 31 Jul. 1965 51 p refs *Its* Ser. 6, Issue 34 (NASA-CR-54406) CFSTI: HC $3.00/MF $0.50 CSCL 13H

Investigation of cesium ion sputtering of monocrystalline copper using a radioactive tracer technique has continued. During the past quarter, the yield and angular distribution of sputtered copper has been measured as a function of cesium ion energy variation from 1 to 10 KeV. It was found that temperature variation had little effect, but that alignment of the beam parallel to a high (Miller) index direction greatly enhanced the yield. The angular data has been successfully fitted to an analytic function through use of a non-linear regression analysis. This method will be used to describe the effects of the above parameters on the angular distribution. Further progress in the development of a mercury ion sputtering apparatus and in a time-of-flight velocity spectrum technique is presented, as well as initial work in developing a technique for measuring small surface densities through use of proton induced characteristic x-rays. Finally, a project to study saturated ion implantation distributions has been initiated. An analysis of expected distributions using a linear model of the combined implantation-sputtering phenomena is presented. Author

N65-32699# Air Force Dept., Washington, D. C.
TRENDS IN HARD MATERIALS
John N. Dick, Charles P. Downer, Fred L. Hill, and Robert L. Vaughn Jan. 1965 40 p refs Rept. of Task Force No. 3 of the Ad Hoc Tool Advisory Comm. (AD-617759)

Present and future demands in the aerospace industry for metals which are difficult to machine were surveyed. These metals include steel and titanium alloys, filament and composite laminate materials, and refractory metals. Information concerning demands for these materials was received from aerospace industry and specialty materials producers. The results show that currently 35% of the demand is for hard-to-machine

metals, while 65% is for easy-to-machine metals. Ten years hence, however, it appears that 70% of the demand will be for hard metals. J.M.D.

N65-32724*# Bell Aerosystems Co., Buffalo, N. Y.
STUDY OF ZERO-GRAVITY POSITIVE EXPULSION TECHNIQUES Interim Report, 16 Jan. 1964–Mar. 31, 1965
Mar. 1965 237 p refs
(Contract NAS7-149)
(NASA-CR-64462; IR-8230-933010) CFSTI: HC $6.00/MF $1.25 CSCL 13H

An IBM program using Fortran II language was used for stress analyses of welded metal bellows of a leaf contour. Considered were both the geometric and the physical nonlinearities. Emphasis was placed upon allowable deflections for changes in curvature in three basic leaf contours of steel bellows; the deformations were confined to the elastic range. Plastic strain values were obtained from a uniaxial stress-strain curve corrected for the biaxial stress condition at each solution point and applied to the case of a clamped circular cylinder under internal pressure. Results of a test program, in which the strains were measured at several points under extension loading, showed good agreement between the measured values and those computed. A Fortran II listing of the program 2260 is included in an appendix. G.G.

N65-32731*# Southwest Research Inst., San Antonio, Tex.
DEVELOPMENT OF WELDING TECHNIQUES AND FILLER METALS FOR HIGH STRENGTH ALUMINUM ALLOYS Second Quarterly Report, 1 Oct.–31 Dec. 1964
N. G. Lenamond, K. K. Speirs, E. Norris, D. L. Davidson, and A. L. Lowenberg 9 Jun. 1965 97 p refs Revised
(Contract NAS8-1529)
(NASA-CR-64534) CFSTI: HC $3.00/MF $0.75 CSCL 13H

A bulge test program was made for evaluating metal inert gas (MIG) and tungsten inert gas (TIG) welding processes and for determining uniaxial and biaxial strength ratio of aluminum alloy weldments. It was found that both the uniaxial and biaxial ultimate strengths of TIG weldments exceeded those of comparable MIG weldments. There were no significant differences between average mechanical properties of another group of MIG and TIG weldments. Uniaxial to biaxial strength ratios for welded panels and for an annealed base panel ranged from 0.84 to 0.89, whereas a value of 1.06 was measured for a specified base metal panel. The membrane stress formula used to calculate biaxial ultimate strength from hydraulic bulge test results appears to require modification. A test program to evaluate weldability of an aluminum alloy was begun, and tensile tests and hardness surveys were completed for TIG weldments aged for periods up to eight weeks. M.W.R.

N65-32759# Joint Publications Research Service, Washington, D. C.
INCREASING THE RELIABILITY OF WELD JOINTS OF AUSTENITIC STEEL STEAM PIPES
M. M. Timofeyev and Yu. M. Nikitin 1 Sep. 1965 11 p refs Transl. into ENGLISH from Teploenerg. (Moscow), no. 8, 1965 p 47–50
(JPRS-31803; TT-65-32298) CFSTI: $1.00

It is shown that upon reducing the inhomogeneity of the properties of various zones of the weld joint the operational reliability of steam pipes used for steam of ultra high parameters is significantly increased. Author

N65-32767# Los Alamos Scientific Lab., N. Mex.
FEASIBILITY OF BRAZED JOINTS BETWEEN Cb-1 Zr ALLOY AND ALUMINA CERAMICS
R. S. Kirby and J. D. La Mutte 25 Aug. 1965 26 p
(Contract W-7405-ENG-36)
(LA-3302-MS) CFSTI: $2.00

Two brazing systems were developed which resulted in ceramic-metal seals whose helium leak-rate was less than 1×10^{-9} cc/sec. Nickel plated Mo-Mn metallized Al_2O_3 ceramics were brazed to Cb-1 Zr metal components using a 55 w/o Cu-45 w/o Ni filler alloy. Unmetallized Al_2O_3—0.5 w/o Y_2O_3 ceramics were brazed to Cb-1Zr metal components using a 48 w/o Ti-48 w/o Zr-4 w/o Be alloy. Both types of joints remained leak-tight during limited cycling tests. Neither system was considered suitable for use above 1000°C as developed. Author

N65-32806# Joint Publications Research Service, Washington, D. C.
INDUSTRIAL APPLICATION OF ELECTRON-BEAM WELDING
O. K. Nazarenko 10 Sep. 1965 56 p refs Transl. into ENGLISH of Chapter III of the book "Elektronno-Luchevaya Svarka" Kiev, 1965 p 79–128
(JPRS-31942; TT-65-32436) CFSTI: $3.00

Low voltage, medium accelerating voltage, and high voltage electron-beam welding guns are discussed in relation to industrial applications. Single stage electrostatic and combined focusing guns are considered in the low-voltage area. The basic parameters and areas of use are included for these guns. General descriptions are given for the medium and high voltage guns. Related topics discussed include pilot-plant and industrial units, general purpose equipment for welding large and small items, equipment for precision machining and welding, equipment for welding in inert-gas and air atmospheres, welding in portable and moving chambers, and shielding operators from X-ray radiation. C.T.C.

N65-32817# Los Alamos Scientific Lab., N. Mex.
FORMING OF TEFLON SHEET BY POWDER ROLLING
H. Sheinberg 5 Aug. 1965 13 p
(Contract W-7405-ENG-36)
(LA-3340-MS) CFSTI: $1.00

This report briefly describes the equipment and process used to form high density Teflon sheet by powder rolling. Data on roll opening and rolled and sintered density for three Teflon powders are presented. Author

N65-32852# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON CERTAIN CHARACTERISTICS OF IRRADIATING LUBRICANTS WHEN STUDYING THEIR RADIATION RESISTANCE
Yu. S. Zaslavskiy, A. D. Stukin, and G. I. Shor 6 Jul. 1965 14 p refs Transl. into ENGLISH from Khim. i Tekhnol. Topliv i Masel (Moscow), no. 10, 1964 p 44–48
(FTD-TT-65-325/1+2+4; AD-618011)

The radiation resistance of lubricants, which depends on their chemical make-up and the intensity and type of ionizing radiation to which they are subjected, is discussed. Both reactors and gamma sources are used to irradiate samples of various lubricants, and the use of a dosimeter which measures absorbed dosages in a homogeneous field of radiation is proposed. This dosimeter, using constant specific heat and the linear increase of the rate of sample heating, is dependent on the absorbed radiation dose measured directly in radians. A sample container dosimeter made of aluminum, a polyethylene sensing element, and thermocouples is described. W.M.R.

N65-32917# Roentgen Technische Dienst N. V., Rotterdam (Netherlands).
NON-DESTRUCTIVE WELDING Quarterly Report No. 11, 1 Jan.–31 Mar. 1964
24 Jul. 1964 22 p Transl. into ENGLISH from Dutch
(Contract EURATOM-045-61-5 VII)
(EURAEC-1152) CFSTI: HC $1.00/MF $0.50

The weld in a test specimen consisting of a rolled plate and a forged block was investigated ultrasonically to determine the extent of induced defects. Incomplete penetration and absence of fusion were found using a single probe technique. Although further discontinuities were found which probably originated from other deliberate defects as cracks, porosity, and gas channels, these discontinuities were difficult to interpret due to a multiplicity of echo indications. As in previous tests, it was found that optimal indications of joint defects and inadequate through-welding were obtained when the probe was placed under an angle of about 15° to the length-axis of the weld. Also included are results of destructive tests. S.C.W.

N65-33005# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
WEAR RESISTANCE OF POLYFORMALDEHYDE IN SLEEVE BEARINGS
V. N. Kestel'man, D. I. Fel'dman, and N. Ya. Kestel'man 9 Jul. 1965 10 p refs Transl. into ENGLISH from Plasticheskiye Massy (Moscow), no. 7, 1964 p 65–66
(FTD-TT-65-329/1+2+4; AD-618058)

Described is a new polymerpolyformaldehyde (PFA) possessing a dense crystalline lattice, which defines its high physico-mechanical properties. The indices of its basic properties are shown. Tests found that sleeve bearings made of PFA are 3 to 4 times more wear resistant than caprone bearings, and 1.5 to 2 times more than ceramet bushings and bearings. The PFA bearings retained stability of dimensions and reliable friction under various conditions of load, lubrication, sliding rate, etc., with a magnitude of wear directly proportional to the friction path. G.G.

N65-33030# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
CONTRIBUTION TO A RESEARCH ON ELECTRON BEAM WELDING OF METALS [CONTRIBUTION A L'ETUDE DE LA SOUDURE DES METAUX PAR FAISCEAU D'ELECTRONS]
Jacques Stohr (Ph.D. Thesis—Paris Univ.) 1964 41 p refs In FRENCH, ENGLISH summary
(CEA-R-2507) CFSTI: HC $2.00/MF $0.50

Tests made with aluminium and an Al-Mg-alloy show indeed a considerable increase of penetrating depth for the latter, in spite of the fact, that the specific heat is practically the same. This increase of penetrating depth can be explained by the pressure, occasioned by additional elements with high vapour pressure, put on the formation of the hole. Micrographs made with welded parts of different metals show melting segregations similar to those obtained when filling a mould of great length. One may point out, that the geometrical configuration adopted by these segregations confirm the hypothesis of the metal flow, as previously contemplated. The study of these segregations, observed during examination through an interferential contrast microscope, has been attempted with a Castaing probe and by radiographical inspection of thin plates: no heterogeneity whatever has been observed. Mechanical tests operated on welded parts, did not show any appreciable difference existing between failure, elongation, yield point and impact values of a welded piece and those of a piece of the basic metal. This method applied on stainless steel shows not only excellent results, but also that the number of calories provided per length unit increases slightly with the welded thickness, whereas one could have expected a linear expression. Author

N65-33073# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
FEED RATE CHECKS ON NUMERICAL CONTROLLED MACHINES
C. E. Durbin 25 Aug. 1965 13 p
(Contract AT(29-1)-1106)
(RFP-570) CFSTI: $1.00

The effects of various feed rates on the intended tool path of numerically controlled boring and turning machines were investigated. The test were conducted on several types of precision machines at Rocky Flats Plant. The amount of tool overshoot and vibration was recorded. Author

N65-33166# Pratt and Whitney Aircraft, Middletown, Conn.
SINGLE HYBRID JOURNAL BEARING TESTS IN WATER
L. Knudsen Jul. 1965 29 p refs
(Contract AT(30-1)-2789)
(TIM-925)

An orifice compensated hybrid hydrostatic journal bearing was tested in water. The test results followed the zero speed theoretical trends with slightly greater load capacity which increased as the journal speed was increased. The lubricant flow rate remained constant for all speeds at constant supply pressure differentials. The 1.5 inch bearing was tested at a diametral journal clearance of .0036 inch with orifices of .030 to .052 inch diameter under differential supply pressures from 12.5 to 80 psi, at speeds from zero to 10,000 rpm and radial loads from zero to 40 pounds. Author

N65-33168# General Electric Co., San Jose, Calif., Atomic Power Equipment Dept.
SURVEY OF PIPING FAILURES FOR THE REACTOR PRIMARY COOLANT PIPE RUPTURE STUDY
W. S. Gibbons and B. D. Hackney Washington, AEC, May 1964 195 p refs
(Contract AT(04-3)-189)
(GEAP-4574) CFSTI: $5.00

An industrial piping failure survey covering 701 contacts in electric utilities, petroleum refineries, chemical processing, marine applications, architect–engineers, component manufacturers, piping fabricators and erectors, insurance companies, and others was conducted as part of the Reactor Primary Coolant Rupture Study. Qualitative conclusions were derived as to the nature of possible failures in present nuclear primary piping systems. Piping systems which were designed and constructed within established code criteria will exhibit high reliability, and a catastrophic, complete severance rupture appears unlikely to occur. The most likely location for failure to occur is in the pipe or pipe-weld heat-affected zone, particularly in association with a structural discontinuity. The importance of adequate monitoring and surveillance must be emphasized, and must be considered in terms of possible nuclear hazards and the ability of monitoring and surveillance procedures to detect incipient failures. R.W.H.

N65-33193*# Frebank Co., Glendale, Calif.
PRESSURE SWITCH—20M32007 Monthly Progress Report No. 4, Oct. 1964
A. E. Davis 15 Nov. 1964 54 p
(Contract NAS8-11670)
(NASA-CR-64784) CFSTI: HC $3.00/MF $0.50 CSCL 13H

Continued research conducted under a program designed to develop, fabricate, and perform pre-flight certification testing of Saturn-V, S-1C pressure switches, is reported. Sixteen sets of Bellevilles were fabricated, evaluated against previous standards of physical and performance tolerances, and used for the adjustment of formulas for theoretical calculations. To study the performance differences from individual Bellevilles of the same stacks, tests were run in parallel stack configuration. In the area of sensor tests, the burst test program was completed with the development of a new formula which provides 5% prediction capability. Also initiated were diaphragm tests to study the effect of platings on rate of behavior, tests to study the effect of thickness on change rates, and tests to study the effect of test treatment on diaphragm performance. The completion of the design of a switch blade test fixture for adaption to the Instron Tester is also reported. S.C.W.

N65-33215# Goodrich (B. F.) Co., Akron, Ohio. Aerospace and Defense Products.
PRESSURIZED BOW DOME OF A CABLE-REINFORCED RUBBER CONSTRUCTION FOR USE WITH AN/SQS-26 SONAR Quarterly Summary Report, 30 Jun.–30 Sep. 1964
R. D. Tubaugh 30 Sep. 1964 82 p
(Contract NObsr-89483)
(Rept.-18; AD-461616)

Progress is reported on the development of a pressurized, cable reinforced, rubber bow dome acoustic window for the AN/SQS-26 sonar. Prototype panel test results indicate that sufficient strength of construction and integrity of shape was designed into the acoustic membrane. Design of the building molds and hydrostatic test fixture was completed and the tooling is being fabricated. The bow dome as modified by the reinforced rubber acoustic window is hydrodynamically acceptable. In the sample testing program, progress is being made in improving membrane construction to assure maximum operational reliability. Studies are continuing on the effect of forces on the window during turning. The effect of forces on window deflection in straight ahead movement is presented under prescribed boundary conditions. The system necessary for pressure regulation within the dome is being investigated. Means of determining the quality of window construction is being evaluated using both X-ray and acoustic methods. The best method of dome interior access while the ship is afloat is by removing water from the dome and pressurizing with 15 psi of air. R.N.A.

N65-33235# Aeronutronic, Newport Beach, Calif. Research Labs.
SEALS AND ADHESIVES FOR TELESCOPING PRESSURIZED STRUCTURES
W. Bandaruk, N. E. Quackenbush, and G. G. Herzl Oct. 1964 40 p refs Presented at the 20th Anniv. Conf. of Soc. of the Plastics Ind., Chicago, Feb. 1955
(Contract AF 33(616)-7775)
(U-2852; AD-462510)

A telescoping pressurized structure design employing a set of cylindrical sleeves and necessary elastomer coated fabric diaphragms bonded between the sleeves was developed and demonstrated. The coated fabric performs as a rolling diaphragm between the concentric sleeves and hermetically seals the telescoping sections during deployment. Various synthetic elastomer impregnated fabrics were screened for the flexible seal. A number of adhesives and primes were investigated for attaining an airtight seal. Friction tests conducted on the telescoping seal indicated that the inherent friction in the system was very low. The seal integrity was evaluated to internal pressure forces of up to 15 psig. The seal demonstrated satisfactory mechanical movement and pressure integrity in a telescoping structure approximately 19 inches in diameter by 45 inches long. R.N.A.

N65-33237# Goodrich (B. F.) Co., Akron, Ohio. Aerospace and Defense Products Div.
PRESSURIZED BOW DOME OF A CABLE-REINFORCED RUBBER CONSTRUCTION FOR USE WITH AN/SQS-26 SONAR Quarterly Summary Report, Sep. 30–Dec. 31, 1964
W. J. Berus 31 Dec. 1964 71 p refs
(Contract NObsr-89483)
(Rept.-22; AD-463412)

The building molds for the forward-port and forward-starboard window sections were received and they were heat stabilized, dimensionally checked and prepared for production use. The aft-port and aft-starboard window section molds are scheduled for delivery. Internal and external handling structures have been designed, and in part, ordered. These will greatly simplify handling of the individual window sections as well as the entire acoustic window. Refurbishing of the test panel mold was completed and the constructional strength of the acoustic window has been increased by reducing the wire count from 14 to 10 ends/inch. Salt water soakage of single ply weftless wire fabric has continued 11 months without any indication of degradation. Continued testing of representative splice samples has been successfully accomplished. The hydrodynamic acceptability of the rubber acoustic window with both the DL-1 and DLG-26 ships has been verified with the DTMB computer program. Author

N65-33246# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
METAL EXTRUSION USING HYDROSTATIC PRESSURE [LE FILAGE DES METAUX SOUS PRESSION HYDROSTATIQUE]
Charles Sauve Feb. 1965 41 p refs
(CEA-R-2750)

A method for extruding metal is described, in which the extrusion process is made possible through the use of hydrostatic pressure. The process can be applied on an industrial scale, with lubricants used to transmit the pressure. Good lubrication inherent in this technique produces surfaces of quality comparable to machined metal. Transl. by J.M.D.

N65-33365*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
METAL-FORMING TECHNIQUES
Ilia I. Islamoff (Hayes Intern. Corp.) Washington, NASA, May 1965 59 p refs Prepared by Hayes Intern. Corp.
(NASA-SP-5017) GPO: $0.40; CFSTI: MF $0.50 CSCL 13H

Metal forming techniques for sheet and plate materials presently employed by the aircraft and aerospace industries are described. These techniques include draw forming, rubber forming, rubber bag forming, hydroforming, marform, hi-draw, drop hammer forming, impacted rubber forming, hot forming with rubber, androforming, spinforming, die-quench forming, hydrodynamic die-quench forming, metallic shot technique, stretch forming, creep forming, incremental-dish forming, shot peening, hydraulic bulge forming, age forming and sizing, hot drape forming, explosive forming, electrohydraulic forming, magnetic forming, and roll extrusion technique. R.N.A.

N65-33384# Western Gear Corp., Lynwood, Calif. Systems Management Div.
CYCLOIDAL CAM TRANSMISSION, PHASES II AND III
May 1965 90 p refs
(Contract DA-44-177-TC-651)
(USAAML-TR-64-13; AD-616905)

This report covers a discussion of the basic theory of operation of the cycloidal cam reducer and the results of load testing on two 280-horsepower units. During testing of the first unit, excessive deflection in the reverter cage assembly resulted in improper load distribution and in the failure of bearings and other components. The failure was analyzed, and modifications were incorporated in the second unit. Failure was experienced in the early stages of testing on the second unit. This failure has been attributed to excessive bearing internal clearance and end play that caused skewing of the crank shaft bearings and severe abrasion of the shaft. Although the second unit was much more efficient than the original, power losses and excessive complexity remain as factors limiting the application of the cycloidal cam reducer for helicopter main transmissions. Author

N65-33410# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONTRIBUTIONS TO THE STUDY OF THE PLASMA JET
David Popovici and Mircea Hrelescu 25 May 1965 9 p refs Transl. into ENGLISH from Constructia de Mashini (Rumania), v. 16, no. 2, 1964 p 81–84
(FTD-TT-65-141/1+2+3+4; AD-467251)

The plasma jet and its application for cutting nonferrous metals and stainless steels is considered. Measurements were made by means of a calorimeter to determine the quantity of heat yielded by the source and absorbed by the workpiece (useful heat). Experimental results, presented in tabular and graphic form, indicate that the useful heat of an argon plasma jet increases with an increase in current and gas flow. The useful heat decreases with an increase in the distance between the end of the electrode and the nozzle, as well as with an increase in the distance between the nozzle and the workpiece. G.A.L.

N65-33431# Joint Publications Research Service, Washington, D. C.
ELECTROSLAG REMELTING
B. I. Medovar and Yu. V. Latash 16 Sep. 1965 67 p Transl. into ENGLISH of the brochure "Elektroshlakovyy Pereplav" Kiev, 1965 p 3–80
(JPRS-32032; TT-65-32526) CFSTI: $3.00

This brochure describes a new method for producing special steels and alloys of extra high quality—Electroslag Remelting (ESR). Data concerning the quality of electroslag metal and effectiveness of employing it in various branches of contemporary engineering are given. The brochure is intended for a wide circle of engineering and scientific personnel (metallurgists, welders, mechanical engineers, physical metallurgists, designers, etc.) and it can also be helpful for university students studying specialized technical subjects. Author

N65-33475# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LUBRICANT FOR PROCESSES OF UPSETTING AND DRAWING OF METALS
L. L. Baybakova, Z. G. Smolkotina et al 14 Apr. 1965 5 p Transl. into ENGLISH from Russian Patent No. 161856 (Appl. No. 821339/23-4, 23 Feb. 1963) 1 p
(FTD-TT-64-1197/1; AD-614960)

The use of calcium soaps of synthetic fatty acid fraction C_5–C_6 as a lubricant for drawing metals is proposed. The lubricant increases the steadiness of the working tool by a factor of three in the drawing of nonferrous metals (brass and the alloy AMT–5). Good results are also obtained in cold upsetting of wood screw blanks made of brass wire. The technology of the preparation of the lubricant is outlined. W.M.R.

N65-33491# Rocketdyne, Canoga Park, Calif.
RESEARCH IN THE FIELD OF LIQUID-METAL-LUBRICATED BEARINGS . Quarterly Progress Report, Period Ending 15 Jun. 1965
25 Jun. 1965 60 p refs
(Contract AF 33(657)-10553)
(R-5086-7; AD-465546)

A program designed to investigate potassium lubricated bearings has been continued. Performance tests of special hybrid bearings in the simulated system test rig using water were concluded and data were reduced. Analyses were performed to predict bearing performance. Correlation between analysis and test data is excellent and typical results are presented. Preparations are now under way for potassium lubricated simulated system tests at temperatures up to 1200° F. Author

N65-33495# Battelle Memorial Inst., Columbus, Ohio.
EFFECT OF OUTPUT CURRENT WAVEFORM ON THE PROPERTIES OF ALUMINUM WELDS
H. E. Pattee Huntsville, Ala., Army Missile Command, Apr. 1965 40 p refs
(Contract DA-01-021-AMC-11706(Z))
(RSIC-402; AD-467836)

A review of recent studies to determine the effects of power-supply output current waveform on the properties of aluminum welds has been conducted. Current developments in power-supply technology have resulted in the design of welding power sources with unusual output characteristics that significantly affect the behavior of the processes used to weld aluminum. Much of the emphasis has been directed toward the development of alternating-current power sources with square-wave current outputs. Power units that permit variation in the duration of the straight- and reverse-polarity pulses have been designed with the goal of obtaining the benefits associated with the direct-current welding process. Significant improvements in the metal-transfer characteristics of the gas metal-arc process have resulted from the use of pulsed power sources. Author

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N65-32653 Joint Publications Research Service, Washington, D. C.
SPECTRUM OF THE SECOND HARMONICS PRODUCED IN THE ADP CRYSTAL BY ND^{3+} EXCITED GLASS IN ITS EXCITED LIGHT EMISSION STATE
Ying-shih Tsai, Hsi-shan Li, and Fu-hsi Kan *In its* Transl. on Communist China's Sci. and Tech., No. 203 9 Aug. 1965 p 98–102 refs (See N65-32650 21-34) CFSTI: $5.00

Excited light was produced by a neodymium-mixed glass rod 90 mm in length and 3 mm in diameter; and spectra produced in the ADP crystal by $CaWO_4:Nd^{3+}$ are reported. The light focusing system was composed of a 400 mm spherical reflecting mirror; distance between the xenon flash lamp and the glass rod was approximately 20 mm. An output energy of about one joule produced second harmonics radiation and light pulsations of approximately one millisecond in duration. Wavelength of excited light produced by the Nd^{3+} excited glass was about 1.06 micron. A bright green flash was observed at about 0.53 micron when the frequency was doubled, and a Hilger

quartz photo spectrum instrument was used to record this flash. Illustrations are included for equipment for observing the wave shape of second harmonics and taking the photo of the spectrum. M.W.R.

N65-32677 Library of Congress, Washington, D. C. Aerospace Technology Div.
RAMAN SCATTERING LASERS
Yuri Ksander *In its* Foreign Sci. Bull., Vol. 1, No. 8 Aug. 1965 p 9–17 refs (See N65-32675 21-34)

Recent Soviet contributions to the theory and applications of lasers based on the stimulated Raman scattering effect are reviewed in the light of the quantum mechanical, classical, and semiclassical methods. The excitation threshold and line intensity of SRS in a variety of organic compounds and certain semiconductors are analyzed. Use of the ruby, neodymium-doped glass, and optically pumped semiconductor lasers for excitation of SRS is discussed. Author

N65-32818# Stanford Univ., Calif. Stanford Linear Accelerator Center.
LASER BEAMS: THE PRODUCTION OF POLARIZED AND MONOCHROMATIC GAMMA RADIATION BY MEANS OF COMPTON SCATTERING AT ELECTRON SYNCHROTRONS AND LINEAR ACCELERATORS
Richard H. Milburn (Tufts Univ.) May 1965 64 p refs
(Contract AT(04-3)-515)
(SLAC-41) CFSTI: $3.00

Practical aspects of the creation of high energy laser-polarized photon beams by the Compton process are examined in detail, and the yields to be expected with contemporary accelerators are estimated. More specifically, the technical problem considered is the production of beams of counter-moving electron and light pulses, each of maximum intensity, such that the spatial and temporal overlap is minimized. Ways are considered for realizing pulsed laser systems which would be suitable for use at electron accelerators, and possible experiments are suggested. J.M.D.

N65-32985# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaire.
CONTRIBUTION TO THE STUDY OF THE MOLECULAR SCATTERING OF LIGHT. USE OF A LASER AS LIGHT SOURCE [CONTRIBUTION A L'ETUDE DE LA DIFFUSION MOLECULAIRE DE LA LUMIERE. UTILISATION D'UN LASER COMME SOURCE LUMINEUSE]
Lucien Slama (Ph.D. Thesis, Paris Univ.) 1964 78 p refs In FRENCH; ENGLISH summary
(CEA-R-2375) CFSTI: HC $3.00/MF $0.75

The experiments of the molecular scattering of light have been repeated using a ruby laser as a light source. The angular distribution of the scattered light intensity has been measured when the electric vector of the incident beam is either in the plane of observation or perpendicular to that plane. In the first case a good agreement with the Rayleigh theory has been found but this is not true in the second case. The differential cross sections for scattering have been measured for various gases. The values found are two or three times larger than the ones deduced from the classical theory. The possible effect of a variation of the beam intensity upon the linearity of the scattering process has been looked for. Author

N65-33397# Cutler-Hammer, Inc., Deer Park, N. Y. Airborne Instruments Lab.
STUDY OF SOLID-STATE AND TRAVELING WAVE MASER TECHNIQUES
J. A. De Gruyl, W. W. Heinz, S. Okwit, and J. G. Smith Griffiss AFB, N. Y., RADC, Mar. 1965 25 p refs
(Contract AF 30(602)-2989)
(RADC-TR-65-30; AD-614651)

The purpose of this program is to develop improved maser techniques and apply them to a broad-band maser system. The final design parameters of the broad-band maser system have been established and a description of the breadboard system is presented in this report. Fabrication and procurement of the breadboard components have begun. A ridged-waveguide semiconductor limiting structure has been developed and the results obtained with it are also presented in this report. Limiting characteristics have been improved; however, additional work is necessary in order to lower the limiting level so that the maser is adequately protected. Author

N65-33401# Naval Ordnance Lab., White Oak, Md.
LASER ACTION BY ELECTRON BEAM PUMPING: STATE OF THE ART, TECHNICAL CONSIDERATIONS, AND GUIDE FOR EXPERIMENTS
Morton Stimler Sep. 1965 47 p refs
(NOLTR-65-95; AD-468832)

This report relates to laser action by electron beam pumping. The papers chosen for review were selected to show the type of work being performed with electron beam pumping, and to form the basis for feasibility conclusions. Calculations intended to provide starting points for future work are also given. These include calculations of ion density in ruby, electron beam density, quantum efficiency, and critical fluorescent power. Also presented is the original data from which a family of curves is generated to predict electron penetration depths into materials of known density. The report concludes with a list of equipment for setting up an electron gun apparatus and a conceptual sketch of a compact, electron beam laser device. The conclusion reached was positive feasibility. This has since been verified. In addition, because of the advantages pointed out in the report, interest in the technique of electron beam pumping has been continually increasing. Author

N65-33409# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE POSSIBILITY OF OBTAINING A SERIES OF POWERFUL SINGLE PULSES ON A RUBY OPTICAL QUANTUM GENERATOR
Yu. V. Bayborodin, V. L. Broude et al 25 May 1965 10 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 9, no. 5, 1964 p 570–573
(FTD-TT-65-134/1+2; AD-467253)

Experiments with a ruby optical quantum generator (OQR) show that several powerful radiation pulses can be obtained during a single ignition. The experiments involved inserting an OQR resonator with mechanical shutter disks into an optical resonator. The shutter disks, which were rotated rapidly, had three series of openings that assured repetition times of 50, 100, and 500 msec, corresponding to a frequency range of 5.10 to 20.0 kc. Ignition duration of the pumping tube was close to 1.2 msec. The results show that if the time of pumping for the generation of the first pulse is 400 msec, generation of successive pulses can be obtained with 50 msec pumping times. It also appears that the 20 kc frequency is not an upper limit. J.M.D.

N65-33421# Hughes Research Labs., Malibu, Calif.
LASER DEVICES EXPLORATORY INVESTIGATION Interim Engineering Report, 5 Apr.–30 Jul. 1965
Viktor Evtuhov [1965] 28 p refs
(Contract AF 33(657)-11650)
(IER-7; AD-468754)

The operating life of the cw ruby laser has been extended to several hours at full power output, and to periods exceeding 40 hours at reduced power output. An increase in incremental efficiency from ~ 5 mW/100 W input to ~ 15 mW/100 W has been obtained by increasing the output coupling. No corresponding increase in the absolute power output has been obtained, however, primarily because of difficulties with the pump lamps. In attempts to improve the operation of the cw ruby laser, a number of different cavity geometries, ruby rods, and pump lamps have been experimentally investigated. The greatest difficulties were found to be associated with the pump lamps. Calculations were performed involving comparisons of the pulse and cw thresholds for ruby as well as the power outputs from three- and four-level systems. Experiments on transverse mode hopping in the cw ruby laser have been performed. In general, mode hopping was found to be less extensive in the cw laser than in the pulsed laser. Author

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N65-32398*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF VARIATIONS IN SILICON AND IRON CONTENT ON EMBRITTLEMENT OF A COBALT-BASE ALLOY (L-605)
Gary D. Sandrock, Richard L. Ashbrook, and John C. Freche Washington, NASA, Sep. 1965 25 p refs
(NASA-TN-D-2989) CFSTI: HC $1.00/MF $0.50 CSCL 11F

An investigation was conducted to study the effect of variations in silicon and iron content in L-605 (HS-25) on room-temperature ductility and other mechanical properties after aging at 1600° F for various times up to 1000 hours. The silicon content of the alloy was investigated over a range from 0.12 to 1.00 percent, and the iron content over a range from 0.16 to 3.24 percent. These ranges are generally within the manufacturer's specified nominal composition limits for these elements. This investigation shows that for low silicon content heats (0.12 to 0.23 percent) the room-temperature ductility of L-605 sheet aged for 1000 hours at 1600° F was improved over that of the high silicon content heats (0.49 to 1.00 percent), as measured by tensile elongations. The former heats had elongations of 13 to 16 percent, the latter had elongations of 2 to 6 percent. Little apparent effect on room-temperature ductility after aging was observed as a result of the variation of iron content from 0.16 to 3.24 percent. Author

N65-32430* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
NONMAGNETIC INTERCONNECT MATERIAL FOR WELDED MODULES
R. M. Jorgensen *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 90-93 (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

While many materials are nonmagnetic, very few approach nickel in terms of its utility as an interconnect material for welded cordwood. The unique characteristics of nickel that lend themselves to a welding interconnect are discussed and the classes of materials which may be investigated in order to find a nonmagnetic material to replace nickel are considered. An experimental approach to determining the feasibility of materials is based upon choosing the same conductor cross section that has been found to be optimum for nickel and comparing the results obtained to the weldability of nickel. The optimum nickel conductor cross section is 0.010 by 0.030 inches and this size is compatible with 0.017 to 0.040-inch diameter gold plated kovar; 0.016 to 0.030-inch diameter dumet; 0.016 to 0.032-inch diameter nickel; 0.016 to 0.032-inch diameter oxygen-free copper; and 0.020 to 0.032-inch diameter ETP copper wires when cross-wire welded. It is noted that nickel is close to being an ideal material in regard to ductility and freedom from weld zone embrittlement. Therefore, equaling the weldability of nickel may not be easy. E.E.B.

N65-32485 National Physical Lab., Teddington (England).
FLOW AND FRACTURE
D. Mc Lean *In* AGARD Advan. in Mater. Res. in the NATO Nations 1963 p 171-192 refs (See N65-32475 21-26) CFSTI: HC $8.35/MF $2.50

A review is presented which locates the boundaries of present knowledge in the fields of flow and fracture, with particular reference to metals. Significant isolated results are: (1) very high speeds—hardening without appreciable deformation can be produced by explosive loading; (2) very high hydrostatic pressure—large increases in yield strength occur at very high hydrostatic pressure with a continuous increase in pressure; and (3) surface effect—thin surface precipitates on sodium chloride were found to nucleate cracks and to account for the Joffe effect. R.W.H.

N65-32497 Centre National de Recherches Metallurgiques, Liege (Belgium).
THE FUNDAMENTAL RESEARCH AND FORMULATION OF ALLOYS [RECHERCHES FONDAMENTALES ET ELABORATION ON DES ALLIAGES]
L. Habraken *In* AGARD Advan. in Mater. Res. in the NATO Nations 1963 p 391-406 refs In FRENCH (See N65-32475 21-26) CFSTI: HC $8.35/MF $2.50

The improvement of mechanical resistance of alloys at eleveated temperatures, and the use of the order-disorder phenomenon to increase this resistance are under study. Results of a theoretical nature from recent work and shown. Considered were modifications which one may realize in solid solutions and dispersed phases to improve creep characteristics. The influence of temperature and the nature of agents are indicated. It is shown that the elastic limit and creep behavior should be improved. The predictions were emphasized and confirmed by recent experiments, and the phenomenon now appears more frequently than previously suspected. R.W.H.

N65-32498 International Nickel Co. Ltd., London (England).
THE CONTRIBUTION OF BASIC RESEARCH TO THE DEVELOPMENT OF WROUGHT NICKEL-BASE CREEP-RESISTING ALLOYS
L. B. Pfeil *In* AGARD Advan. in Mater. Res. in the NATO Nations 1963 p 407-423 refs (See N65-32475 21-26) CFSTI: HC $8.35/MF $2.50

A summary is given of findings that led to the selection of 80/20 nickel-chromium alloys as the basis for initial development of improved creep-resisting alloys. Differences in creep properties between different commercial batches of 80/20 nickel-chromium were quickly traced to variations in residual titanium deoxidizer and carbon. This led to the early development of Nimonic 75. During this period marginal

solubility was formulated. This led to the determination of solubility data to guide selection of alloys for more extended high temperature test. The effect of heat-treatment variables on the properties of nickel–chromium alloys with additions of titanium, particularly Nimonic 80, was empirically investigated. R.W.H.

N65-32499 Bureau of Naval Weapons, Washington, D. C.
REFRACTORY MATERIALS DEVELOPMENT AND ITS DEPENDENCE ON BASIC RESEARCH
N. E. Promisel *In* AGARD Advan. in Mater. Res. in the NATO Nations 1963 p 425–450 refs (See N65-32475 21-26) CFSTI: HC $8.35/MF $2.50

Contributions of basic research to the development of refractory materials are under study. Areas which can assist in solving certain problems are: raw materials; consolidation processes for producing ingots or compacts; primary fabrication; alloy development; flow and fracture characteristics; oxidation and surface protection; and some miscellaneous items. Refractory materials were limited to molybdenum, niobium, tantalum, and tungsten, except in a few cases where other material is specifically mentioned. R.W.H.

N65-32538 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRICAL CONDUCTIVITY AND SPECIFIC VOLUME OF LIQUID METALS
A. N. Solovb'yeb *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 265–272 refs (See N65-32506 21-25)

Experimental data from the literature on electrical conductivity of pure liquid metals over temperature intervals, in conjunction with the author's own data, are compared, organized, and plotted. Analysis of the data showed that the linear dependence of electrical resistance on the temperature is tracked in a relatively narrow temperature interval near the melting point. It was found that the relationship was not always linear. In many cases the atomic electrical resistance was shown to have a linear dependence on specific volume. The dependence of the resistance on relative free volume has a common character. L.S.

N65-32559 Joint Publications Research Service, Washington, D. C.
ON CONTROL OF THE PROCESSES OF MELTING METAL
I. A. Krass *In its* Probl. in Cybernetics 16 Aug. 1965 p 218–251 refs (See N65-32550 21-08) CFSTI: $7.00

An algorithm is investigated for the discrete control of a process for melting metal in a cupola or a blast furnace. The physical model of the process is constructed; the integral laws of conservation of matter, momentum, and energy are considered; boundary conditions are established; and conditions investigated for which the diffusion becomes single valued. Algorithms are constructed which control the physical model obtained. As a result of the investigation of the basic thermochemical system of equations it was found that for the limitations considered the vector of the mean-mass rate of a mixture in the active zone is constant and directed along the axis of the furnace and for the transition to a one-dimensional problem the simplest wave-shaped solutions are obtained for the concentration of coke, metal, and slag. It is also shown that for the selection of an infinitely small step with respect to time the problem is reduced to a problem of the Pontryagin type and for the final determinant step with respect to time to the finite Bellman problem for which it is possible to assume different modified algorithms. E.E.B.

N65-32598*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
DETERMINATION OF THE WELDABILITY AND ELEVATED TEMPERATURE STABILITY OF REFRACTORY METAL ALLOYS Seventh Quarterly Report, Dec. 21, 1964–Mar. 20, 1965
G. G. Lessmann and D. R. Stoner [1965] 58 p refs
(Contract NAS3-2540)
(NASA-CR-54434; WANL-PR(P)-007) CFSTI: HC $3.00/MF $0.50 CSCL 11F

Chemical analysis data for carbon, oxygen, and nitrogen pickup in eighteen TIG welds were obtained and reviewed. No apparent contamination occurred during welding. Thermal stability study welds for the niobium and tantalum alloys were completed, inspected, and are being machined to the required bend and tensile test configurations. An evaluation of the effect of oxygen contamination on the weldability of T-111, T-222, and FS-85 was initiated. Results seem to discriminate between the ductility of T-111 and T-222 at the 150 to 200 ppm oxygen level. Welds in T-111, T-222, and FS-85 were screened for thermal stability at 1800° F. All responded to aging with a measureable rise in the bend ductile–brittle transition temperature. Hardness traverses proved useful for following the aging responses. During the 10^{-10} torr agin runs of 100 and 1000 hours, specimen staining occurred as a result of vapor transfer of hafnium and sirconium. R.N.A.

N65-32645*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INFLUENCE OF CRYSTAL ORIENTATION ON FRICTION CHARACTERISTICS OF TITANIUM SINGLE CRYSTALS IN VACUUM
Donald H. Buckley Washington, NASA, Sep. 1965 12 p refs
(NASA-TN-D-2988) CFSTI: HC $1.00/MF $0.50 CSCL 11F

Friction experiments were conducted in vacuum (10^{-9} mm Hg) with oriented single-crystal titanium rider specimens sliding on polycrystalline titanium disk specimens. Experiments were conducted at a surface speed of 2.28 centimeters per second and loads from 250 to 1000 grams. Two principal single-crystal orientations were examined, one with the primary prismatic slip plane [(1010)] oriented parallel to the sliding interface and the other with the basal plane [(0001)] oriented in this same direction. The friction coefficient for titanium single crystals was less with the prismatic slip plane (primary slip plane for titanium) oriented parallel to the direction of sliding than with the basal slip plane oriented in the direction. These results correlate with the shear stress data for the respective orientations. Recrystallization and texturing occurred at high loads on the single-crystal surface, and friction values were the same as for polycrystalline titanium. Author

N65-32648*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TUNGSTEN–NICKEL–COPPER TERNARY ALLOYS FOR HIGH-TEMPERATURE APPLICATIONS
Ruluff D. Mc Intyre Washington, NASA, Sep. 1965 23 p refs
(NASA-TN-D-3015) CFSTI: HC $1.00/MF $0.50 CSCL 11F

Ternary tungsten–nickel–copper alloys were investigated to develop a fabricable alloy which could be sintered at low temperatures and used at temperatures above 3000° F. The result was a tungsten–0.3-percent-nickel–0.2-percent-copper ternary alloy that exhibited strength and ductility comparable to wrought, recrystallized powder-metallurgy and arc-cast tungsten at temperatures in the vicinity of 3000° to 4000° F, while retaining its capacity for sintering at temperatures as low as 2200° F. Elongation values were comparable to values normally shown for recrystallized tungsten over the temperature interval 3000° to 4000° F. Heat treatment of this alloy following sintering increased the elongation before fracture at

3000° F from 4.0 to 20.0 percent with little loss of strength. In the heat-treated condition, the tungsten–0.3-percent-nickel–0.2-percent-copper alloy could be rolled to a 50-percent-nickel duction in thickness at temperatures of approximately 3000° F. The rolled tungsten–0.3-percent-nickel–0.2-percent-copper alloy 4 T bend transition temperature compared favorably to that of conventional, unalloyed, worked tungsten sheet material. Two other alloy compositions investigated, tungsten–1.5 percent nickel–1 percent copper and tungsten–6 percent nickel–4 percent copper, lost almost all their useful strength and elongation at 2500° F. Author

N65-32655 Joint Publications Research Service, Washington, D. C.
THE RELATIONSHIP BETWEEN THE TRANSFORMATION OF ROLLING TEXTURE AND THE DISPLACEMENT RATE OF ACCUMULATION LAYERS OF NICKEL–MOLYBDENUM ALLOY
Hsin-yu Chang and Hsueh-fan Sun *Ie its* Transl. on Communist China's Sci. and Tech., No. 203 9 Aug. 1965 p 113–120 refs (See N65-32650 21-34) CFSTI: $5.00

Pure nickel and molybdenum were used to prepare five different nickel–molybdenum alloys to study the relationship between the transformation process of rolling texture and the displacement rate of accumulation layer. Molybdenum content of the alloys was 1.19%, 3.37%, 7.11%, 11.10%, and 14.97%. Copper-type texture occurs in the lower Mo-content alloys, and the rolling textures are transformed as Mo content increases. The 14.97% alloy has a brass-type texture. After the brass-type texture is formed, there is a decrease in the displacement rate of the accumulation layer. Research on recrystallized texture indicates that Mo has significant restraining power on such cube formation. With increase in Mo content, recrystallized cube texture is significantly reduced after annealing. M.W.R.

N65-32680 Library of Congress, Washington, D. C. Aerospace Technology Div.
EPITAXIAL GROWTH OF ALUMINUM NITRIDE THIN FILMS
John G. Kourilo *In its* Foreign Sci. Bull., Vol. 1, No. 8 Aug. 1965 p 28–30 refs (See N65-32675 21-34)

A review is presented of two recent Soviet-bloc articles dealing with the preparation technique, properties, and application of aluminum nitride thin films. Homogeneous epitaxial films of aluminum nitride up toe 100 mμ thick were produced on silicon or silicon carbide single crystal substrate by gas discharge in aluminum chloride vapors carried by nitrogen stream. The films displayed good adherence to the substrate and were suitable for use as dielectric diodes. Nonepitaxial thin films of aluminum nitride activated with Mn, Cu, or Si were prepared by the same technique and were used for the study of cathodoluminescence. Author

N65-32708# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON STABILITY OF CERTAIN MATERIALS IN LIQUID ALUMINUM
Kh. V. Keerus, M. M. Saar, and Kh. A. Tiysmus 3 Jun. 1965 14 p refs Transl. into ENGLISH from Tr. Tallinsk. Politekhn. Inst., Ser. A (Tallin), no. 197 1962 p 155–165
(FTD-MT-64-513; AD-618316)

Static tests of materials for use in electromagnetic pump channels were conducted by submerging samples in motionless liquid aluminum in order to select materials with most promising dynamic behavior. Stability of the materials was determined by heating to between 730° and 800° C and followed by fast cooling to room temperature. Changes in surfaces of the materials were determined both visually and microscopically. Results obtained indicate that pure metals and their alloys do not show a noticeable resistance to the corrosive action of fused aluminum. Among the metals tested were cast iron, chrome steel, molybdenum, nichrome, nickel, steel, and tungsten. Nonmetals which could be used in melted aluminum at a temperature around 800° C include porcelain, quartz, pyroceramic sitall, graphite, corundum, and magnesite. Protective coatings of metals are suggested to combine the positive properties of the metallic and nonmetallic materials, and compositions of priming and protective enamels are given. The use of powdered aluminum oxide is also considered. M.W.R.

N65-32715# Argonne National Lab., Ill. Metallurgy Div.
ANNUAL PROGRESS REPORT, 1964
[1964] 294 p refs
(Contract W-31-109-ENG-38)
(ANL-7000) CFSTI: $7.00

Developments related to basic and engineering metallurgy are detailed in a series of reports. Engineering studies deal with subjects such as fast reactor fuel element development and fabrication; plutonium recycle demonstrations; experimental irradiation of fuel and control materials; examination of full-scale reactor fuel elements; and development of alloy fuels and jacket materials, ceramic fuels, corrosion resistant materials, and fabrication and nondestructive methods. Basic studies consider actinide and HCP metals; alloying properties; diffusion, nuclear magnetic resonance, and X-ray and neutron diffraction studies; research on corrosion and ceramic materials; and various irradiation effects. Plant modifications and new facilities are discussed. M.W.R.

N65-32734# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HIGH STRENGTH STEEL
D. A. Prokoshkin 12 Jan. 1965 25 p refs Transl. into ENGLISH from Met., Metallovedeniya. Fiz.-Khim. Metody Issled. (USSR), no. 13, 1963 p 108–121
(FTD-TT-64-679/1+2; AD-610350)

Methods for obtaining high strength steel are discussed. The methods include: hardening with the low annealing, patentizing, thermomechanical processing with deformation of supercooled austenite, gradual hardening, thermomechanical treatment with hot plastic deformation, and thermomagnetic treatment. Author

N65-32741# Watervliet Arsenal, N. Y. Benet R & E Labs.
OXIDATION OF TANTALUM IN CARBON DIOXIDE AND CARBON MONOXIDE
Fumihiko Saegusa Sep. 1964 34 p refs
(WVT-6416; AD-610494)

The oxidation behavior of tantalum in carbon dioxide and carbon monoxide has been investigated in the temperature range of 500° to 700° C. The rate of reaction was determined by measuring a change in electrical resistance of the specimen. The phase and structure changes were examined by using x-ray diffraction and metallographic techniques. The reaction involved solution of dissociated oxygen and formation of oxides, TaO_y, TaO_z and Ta_2O_5. The initial parabolic oxidation by carbon dioxide was represented by the dissolution of oxygen and the subsequent linear oxidation was controlled by a phase boundary reaction. Author

N65-32785# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
THE DELTA TO EPSILON TRANSFORMATION KINETICS IN Pu-1 w/o Ga

R. H. Karlsson and J. E. Pavlick 25 Aug. 1965 12 p refs
(Contract AT(29-1)-1106)
(RFP-498) CFSTI: $1.00

The delta to epsilon phase transformation kinetics in a wire of high purity Pu-1 w/o Ga were studied using the change in electrical resistance as a measure of percent transformation. It was found that the transformation occurs by a nucleation and growth process. There is evidence that the growth of the epsilon phase is unidirectional through the parent phase. An activation energy of approximately 65 kcal/mole was calculated for the reaction at 50 percent completion. Author

N65-32836# Brookhaven National Lab., Upton, N. Y.
EFFECT OF NEUTRON IRRADIATION ON PRECIPITATION OF CARBON IN ALPHA-IRON
A. C. Damask [1964] 16 p refs Presented at Intern. Conf. on Diffusion in Body Centered Cubic Mater., Gatlinburg, Tenn., 16–18 Sep. 1964
(Contract AT(30-2)-GEN-16)
(BNL-8418; CONF-691-4)

The sequence of defect migrations following low temperature irradiation and their effect on the precipitation of carbon in alpha-iron are described. The iron interstitials migrate freely above 80° K and can be trapped at immobile carbon atoms quenched into solution, escape to surfaces, cluster, or annihilate vacancies. An excess concentration of vacancies remains. The interstitial carbon complex has a binding energy of about 0.5 eV and could be stable up to about −30° C. The decrease in resistivity observed at this temperature would then be caused by the escape of the iron interstitials following dissociation. Above room temperature the carbon atom begins to migrate with a motion energy of 0.86 eV. When a migrating carbon atom meets a vacancy it is trapped with a binding energy of 0.41 eV, but this is not apparent after ambient temperature irradiation because all of the carbon atoms migrate to precipitation sites before sufficient vacancies are produced to trap a significant number. Carbon atoms in excess of the vacancies precipitate into a metastable carbide. At temperatures above 230° C, the carbon atoms boil out of the vacancies and precipitate in the Fe_3C phase. R.N.A.

N65-32841# Brookhaven National Lab., Upton, N. Y.
POINT DEFECT CALCULATIONS IN α-IRON
R. A. Johnson [1964] 21 p refs Presented at Intern. Conf. on Diffusion in Body Centered Mater., Gatlinburg, Tenn., 1–8 Sep. 1964
(Contract AT(30-2)-GEN-16)
(BNL-8435; CONF-691-5)

Various properties of point defects in iron, vanadium, and tungsten have been investigated with the aid of computer techniques. The metal-metal interaction was represented by a two-body central force between first and second nearest neighboring atoms which matches the elastic moduli. About 530 atoms surrounding the defect were treated as individual particles, while the remainder of the crystal was treated as an elastic continuum with atoms imbedded in it. For α-iron the calculated activation energies for motion of mono- and di-interstitials and mono- and di-vacancies were 0.33 eV, 0.18 eV, 0.68 eV, and 0.66 eV respectively, and binding energies of di-interstitials and di-vacancies were 1.08 eV and 0.20 eV respectively. For tungsten the corresponding energies for interstitial and vacancy motion were 1.07 and 2.00 eV respectively. The stable interstitial was a "split" configuration in which two atoms were symmetrically split in a (110) direction about a vacant normal lattice site. Author

N65-32843# Bureau of Mines, Norris, Tenn.
GROWTH AND PROPERTIES OF ZIRCONIA AND TITANIA WHISKERS FROM FUSED SALT BATHS
Robert C. Johnson and John K. Alley 1965 19 p refs
(BM-RI-6667)

Single crystal whiskers of ZrO_2 and TiO_2 were grown by solution and crystallization of these oxides in molten baths. Mixtures of $Na_2B_4O_7$ and LiCl were the most suitable growth media for zirconia. Sodium borate alone and Na_2CO_3 plus SiO_2 were best suited for titania. The solubilities of zirconia and titania in molten sodium borate were determined. Whether zirconia whiskers were dendritic or nondendritic depended on the temperature used. The best single crystal whiskers were grown below 1,100° C. Titania whiskers always grew as single crystals. The tensile strengths of zirconia and titania whiskers were about 15,000 psi and 50,000 psi, respectively. Modulus of rupture was about 49,000 psi for zirconia whiskers and 75,000 psi for titania whiskers. Chemical analyses showed the zirconia and titania whiskers to be pure. The zirconia and titania whiskers were shown by X-ray analysis to be, respectively, baddeleyite and rutile. Author

N65-32880*# Hydronautics, Inc., Laurel, Md.
CAVITATION DAMAGE IN LIQUID METALS Technical Progress Report, 1 Apr.–31 May 1965
A. Thiruvengadam, H. S. Preiser, and S. L. Rudy 30 Jun. 1965 32 p refs
(Contract NAS3-4172)
(NASA-CR-54459; TPR-467-3) CFSTI: HC $2.00/MF $0.50 CSCL 11F

Cavitation damage resistance of Stellite 6B, 316 stainless steel, Cb-132M, TZM and T-222 in liquid sodium at 400° F, 1000° F and 1500° F is reported. The test duration is an important parameter in evaluating their relative resistance. Satellite 6B exhibits the best resistance among the metals tested. High frequency fatigue results for 316 stainless steel and TZM in liquid sodium at 1000° F and at 1500° F are presented. The fatigue of 316 stainless steel in 1500° F sodium at 14000 cps is compared with the results obtained in 1500° F vacuum (3×10^{-5} torr) at 4-5 cps and there seems to be good agreement between these results. No stress corrosion cracking of 316 stainless steel was observed in 1000° F sodium up to 100 percent yield over a test period of 60 hours. Author

N65-32978# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
STUDY OF URANIUM–PLUTONIUM ALLOYS CONTAINING FROM 0 TO 20% OF PLUTONIUM [ETUDE DES ALLIAGES URANIUM–PLUTONIUM AUX CONCENTRATIONS COMPRISES ENTRE 0 ET 20% DE PLUTONIUM]
Hanoch Parus (Ph.D. Thesis, Paris Univ.) 1963 61 p refs In FRENCH; ENGLISH summary
(CEA-2321) CFSTI: HC $3.00/MF $0.75

The work is carried out on U–Pu alloys in the region of the solid solution uranium alpha and in the two-phase region uranium alpha + the zeta phase. The results obtained concern mainly the influence of the addition of plutonium on the physical properties of the uranium (changes in the crystalline parameters, the density, the hardness) in the region of solid solution uranium alpha. In view of the discrepancies between various published results as far as the equilibrium diagram for the system U–Pu is concerned, an attempt was made to verify the extent of the different regions of the phase diagram, in particular, the two-phased region. Author

N65-32979# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaire.

STUDIES ON TEMPERING AT DIFFERENT TEMPERATURES OF THE BETA PHASE RETAINED BY WATER QUENCHING IN URANIUM–CHROMIUM ALLOYS CONTAINING FROM 0.37 TO 4 ATOMS OF CHROMIUM% [ETUDE DU REVENU A DIFFERENTES TEMPERATURES DE LA PHASE BETA RETENUE PAR TREMPE A L'EAU DANS LES ALLIAGES URANIUM–CHROME CONTENANT DE 0.37 A 4 ATOMES% DE CHROME]

Michel Degois (Ph.D. Thesis, Nancy Univ., 1962) 1963 48 p refs In FRENCH; ENGLISH summary
(CEA-R-2340) CFSTI: HC $2.00/MF $0.50

The author made a systematic study of the annealing of the beta phase, retained by water-quenching, in uranium-chromium alloys of concentrations between 0.37 and 4 chromium percent. It is shown that alloys containing less than 1 at. percent are transformed at temperatures between room temperature and 250° C according to a bainitic process involving activation energies of the order of 14 500 cal/mole. Alloys containing more than 1 at. percent are transformed at temperature between 400° and 650° C by way of a germination and growth process involving an activation energy of the order of 33 000 cal/mole. The limit of solubility of chromium in beta uranium plays a fundamental part in the transformations of the alloys. The TTT curves of beta to alpha transformation were drawn by the use of a thermodilatometer of very low inertia. The transformation law may be expressed $1 - x = \exp. -(kt)^n$; x represents the degree of progression of the transformation, k a coefficient dependent on the temperature, and n an exponent depending only on the composition of the alloy. A micrographic and crystallographic study confirmed the results found by dilatometry; in particular, it was possible to measure the progression rates of the transformation. Author

N65-32980# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaire.

STUDY OF THE TRANSFORMATION OF URANIUM–NIOBIUM ALLOYS WITH LOW NIOBIUM CONCENTRATIONS, TEMPERED FROM THE GAMMA AND BETA + GAMMA$_1$ REGIONS AND THEN ANNEALED AT DIFFERENT TEMPERATURES. COMPARISON WITH URANIUM–MOLYBDENE ALLOYS [ETUDE DES TRANSFORMATIONS DES ALLIAGES URANIUM–NIOBIUM A FAIBLE TENEUR EN NIOBIUM TREMPES DEPUIS LES DOMAINES GAMMA ET BETA + GAMMA$_1$ PUIS REVENUS A DIFFERENTES TEMPERATURES. COMPARAISON AVEC LES ALLIAGES URANIUM–MOLYBDENE]

Claude Collot (Ph.D. Thesis, Nancy Univ., 1962) 1963 48 p refs In FRENCH; ENGLISH summary
(CEA-2341) CFSTI: HC $2.00/MF $0.50

Uranium–niobium alloys, like uranium–molybdenum alloys, tempered from the gamma region, give a martensitic phase with a structure deriving from that of alpha uranium by a slight contraction parallel to the axis [001]. The critical cooling rate allowing the formation of this martensite is 80° C/s at 750° C. Retention of the beta phase of uranium–niobium alloys is particularly difficult, the critical retention rate being 700° C/s at 668° C for an alloy containing 2.5 at. percent of Nb. This beta phase is completely converted to the alpha phase at room temperature in about 6 hours. The beta phase conversion law is expressed as: $1-x = \exp. -(kt)^n$ x being the degree of progression of the conversion, t the time, n an exponent nonvarying with temperature and having approximately the value 2 for the alloy considered, k an increasing function of temperature. The activation energy of conversion is of the order of 14,600 cal/mole. Niobium is much less active than molybdenum as a stabilizer of beta uranium. Author

N65-32983# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaire.

THE COMPATIBILITY OF VARIOUS AUSTENITIC STEELS WITH MOLTEN SODIUM [COMPATIBILITE DE DIVERS ACIERS AUSTENITIQUES AVEC LE SODIUM FONDU]

L. Champeix, J. Sannier, R. Darras, W. Graff, and P. Juste 1963 28 p refs In FRENCH; ENGLISH summary
(CEA-2371) CFSTI: HC $2.00/MF $0.50

Various techniques for studying corrosion by molten sodium have been developed and applied to the case of 18/10 austenitic steels. The results obtained are discussed as a function of various parameters: type of steel, temperature, oxygen content of the sodium, surface treatment, welds, mechanical strain. In general, these steels have an excellent resistance to sodium when the latters oxygen content is limited by a simple purification system of the "cold trap" type, and when an attempt is made to avoid cavitation phenomena which are particularly dangerous, as is shown by the example given. Author

N65-32992# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

THE COMPATABILITY OF CHROMIUM-ALUMINUM STEELS WITH HIGH-PRESSURE CARBON DIOXIDE AT INTERMEDIATE TEMPERATURES [COMPATIBILITE des ACIERS au CHROME-ALUMINUM AVEC le GAZ CARBONIQUE SOUR PRESSION aux TEMPERATURES MOYENNES]

Daniel Leclercq, Henri Loriers, Rene David, and Raymond Darras Apr. 1964 31 p refs In FRENCH; ENGLISH summary
(CEA-R-2423) CFSTI: HC $2.00/MF $0.50

With a view to their use in the exchangers of nuclear reactors of the graphite-gas or heavy water-gas types, the behavior of chromium- aluminum steels containing up to 7 percent chromium and 1.5 percent aluminum has been studied in the presence of high-pressure carbon dioxide at temperatures of between 400 and 700° C. The two most interesting grades of steel (2 percent Cr–0.35 percent Al–0.35 percent Mo and 7 percent Cr–1.5 percent Al–0.6 percent Si) are still compatible with carbon dioxide up to 550 and 600° C respectively. A hot dip aluminised coating considerably increases resistance to oxidation of the first grade and should make possible its use up to temperatures of at least 600° C. Author

N65-32994# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

TRANSMISSION ELECTRON MICROSCOPE EXAMINATION OF RARE-GAS BUBBLES IN METALS: ANALYSIS OF OBSERVED CONTRAST EFFECTS [EXAMEN AU MICROSCOPE ELECTRONIQUE EN TRANSMISSION DE BULLES DE GAZ RARE DANS LES METAUX: ANALYSE DES EFFETS DE CONTRASTE OBSERVES]

Viviane Levy Oct. 1964 20 p In FRENCH; ENGLISH summary
(CEA-R-2431) CFSTI: HC $1.00/MF $0.50

Metallic samples containing rare gas bubbles have been examined by transmission electron microscopy. The different features of the contrast patterns of the bubbles have been explained by the dynamical theory of contrast, assuming that the bubble behaves as a hole in the metal. Experimental results are in good agreement with the theory. Author

N65-33000# California Univ., Berkeley. Lawrence Radiation Lab.

VAPOR PRESSURE DETERMINATION OF MANGANESE ACTIVITIES IN IRON–MANGANESE ALLOYS

Prodyot Roy (Ph.D. Thesis) Aug. 1964 30 p
(Contract W-7405-ENG-48)
(UCRL-11575)

The Gibbs energies, heats, and entropies of formation of face-centered-cubic gamma-phase iron–manganese alloys at high temperatures were investigated. Depletion of manganese from the surface of the sample depends on the relative rates of evaporation versus diffusion. If diffusion is fast enough, the surface loss of manganese can be restored by diffusion from the interior so that the surface concentration is slightly less than the sample as a whole. If the diffusion is slow, the surface will quickly be depleted to a low concentration with an accompanying decrease in the measured vapor pressure. The rate at which manganese is replenished from the interior of the sample is proportional to Ddx/dl where D is the diffusion coefficient and dx/dl is the concentration gradient between the surface and the interior. D varies with temperature so the $D\alpha\ e^{-(Q/RT)}$ where Q is the activation energy for diffusion. R.W.H.

N65-33008# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF LIMIT VALUES OF ACTIVATION ENERGY OF CREEP OF TITANIUM–ZIRCONIUM ALLOYS
K. A. Osipov and A. L. Sotnichenko 9 Jul. 1965 13 p refs Transl. into ENGLISH from Issled. po Zharoproch. Splavam, Akad. Nauk SSSR, Inst. Met. (Moscow), v. 10, 1963 p 27–31 (FTD-TT-65-88/1+2+4; AD-618008)

The results on the study of creep in polycrystalline alloys of tianium–zirconium in the α modification is presented. Investigations were conducted on alloys that were smelted in a vacuum arc furnace, and every ingot was remelted two or three times to obtain uniformity. The values of constant applied stress used in the tests were 30, 35, 40, 45, 50, 55, 60, 65, and 70 kg/mm^2. Results combining temperature and stress showed that the logarithm of rate of steady creep on reverse temperature is rectilinear. The activated state during creep under large applied stresses corresponds in character to local polymorphous transformation. W.M.R.

N65-33023# Atomic Energy of Canada Ltd., Chalk River (Ontario).
ETCHANTS FROM INCONEL ALLOYS X-750 AND 600
G. C. Lloyd (Queens Univ., Kingston) Jun. 1965 22 p refs (AECL-2271) CFSTI: HC $1.00/MF $0.50

The characteristics and relative effectiveness of the known etchants of Inconel Alloys X-750 and 600 were investigated. The etchants studied, both chemical and electrolytic, were for both optical and electron microscopy. The characteristics of the etchants are listed and the recommended etchants for each group are given. Photomicrographs of typical structures etched with the recommended etchants are included. Author

N65-33033# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
CONTRIBUTION TO THE STUDY OF HELIUM PRECIPITATION IN AN ALUMINUM–LITHIUM ALLOY [CONTRIBUTION A L'ETUDE DE LA PRECIPITATION DE L'HELIUM DANS UN ALLIAGE ALUMINIUM–LITHIUM]
Viviane Levy, Jacqueline Antolin, Jacqueline Espinasse, and Yves Adda Jul. 1964 36 p refs In FRENCH; ENGLISH summary
(CEA-R-2529) CFSTI: HC $2.00/MF $0.50

In order to determine the swelling mechanisms we have studied the behavior of helium in aluminum using transmission electron microscopy. The helium was introduced into the aluminum by irradiation of Al–Li^6 alloys containing small amounts of lithium. The influence of various factors on the nucleation and the swelling of the bubbles has been studied. They are: the helium concentration, the temperature, the number and the distribution of crystal defects in the metal. We have shown furthermore that the precipitation of rare-gas bubbles could in certain cases prevent the recrystallization of the metal as a result of a mechanism depending on the anchoring of the dislocations and grain boundaries by the bubbles.
Author

N65-33117# Materials Research Corp., Orangeburg, N. Y.
IRON SINGLE CRYSTAL PREPARATION Final Approved Report, 2 Apr. 1963–1 Apr. 1964
E. J. Hughes, P. W. Barton, and R. D. Vigue [1964] 63 p refs (Contract AT(30-1)-2980)
(MRC-489)

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2. SOME EXPERIMENTS ON THE USE OF THE ELECTROTRANSPORT PHENOMENON FOR THE FURTHER PURIFICATION OF ELECTRON BEAM ZONE REFINED IRON E. J. Hughes, P. W. Barton, and R. D. Vigue 32 p refs (See N65-33119 21-17)

N65-33118 Materials Research Corp., Orangeburg, N. Y.
THE PREPARATION OF THE CRYSTALS AND A STUDY OF THEIR MECHANICAL AND ELECTRICAL PROPERTIES AT LOW TEMPERATURES
E. J. Hughes, P. W. Barton, and R. D. Vigue 19 Apr. 1964 *In its* Iron Single Crystal Prepn. [1964] 31 p refs (See N65-33117 21-17)

A strain anneal method for the preparation of single crystals from polycrystalline electron beam zone refined iron is described. Extensive analyses carried out on both the starting material and the crystals indicate that the principal impurities in the latter are tungsten ~ 25 ppm, carbon ~ 10 ppm, oxygen ~ 8 ppm, and nitrogen ~ 0.9 ppm. The tensile properties of crystals having orientations covering the whole stereographic triangle were studied at −196° C. The results obtained differed strongly from those obtained by earlier workers using less pure crystals in that ductility was observed in all orientations. Electrical resistance measurements made at room temperature and 4.2° K gave resistance ratio values for the crystals of between 200 and 300. Author

N65-33119 Materials Research Corp., Orangeburg, N. Y.
SOME EXPERIMENTS ON THE USE OF THE ELECTROTRANSPORT PHENOMENON FOR THE FURTHER PURIFICATION OF ELECTRON BEAM ZONE REFINED IRON
E. J. Hughes, P. W. Barton, and R. D. Vigue 23 Nov. 1964 *In its* Iron Single Crystal Prepn. [1964] 32 p refs (See N65-33117 21-17)

A study designed to determine the feasibility of using the electrotransport method for the further purification of electron beam zone refined iron is reported. Utilized was an apparatus which allowed heavy currents to be passed through a metal rod while it was maintained in a vacuum or inert atmosphere and its ends kept near room temperature by water cooling. A series of iron specimens were prepared for a single rod of electron beam zone refined iron which contained a total impurity content of about 50 ppm. A direct current of 70 amps was passed through each of three of the specimens for a period of 72 hours. Similar experiments were performed on two specimens using alternating instead of direct current. The impurity

distribution along the lengths of each of the specimens was examined by making resistance ratio measurements. Results of dc and ac experiments were compared to determine effects due to the Soret effect and those due to electrotransport. Although in the dc experiments, electrotransport had caused a measurable movement of impurities away from the anode, this effect was small as compared to the Soret diffusion which accompanied it. It is concluded that further research is needed in view of the discouraging results obtained from these experiments. S.C.W.

N65-33162# National Lead Co. of Ohio, Cincinnati. Feed Materials Production Center.
[CHEMICAL AND METALLURGICAL STUDIES OF THORIUM AND URANIUM REACTOR FUELS] Summary Technical Report, Apr. 1–Jun. 30, 1965
R. Burgett and B. J. Thomas, ed. 11 Aug. 1965 72 p ref
(Contract AT(30-1)-1156)
(NLCO-955) CFSTI: $3.00

A summary technical report on the following topics is presented: (1) X-Ray Spectrometric Determination of Thorium in Aqueous and Organic Solutions—development of new X-ray methods; (2) The Neutron Activation Facility at the National Lead Company of Ohio—equipment for supply of fast and thermal neutrons; (3) A Versatile Sequential Programing Timer—development of timer for operational control of neutron activation analysis; (4) Studies of Precipitation in Uranium-UAl_2 Alloys by Electron Microscopy—electron microscopy of as-cast, and of heat-treated uranium-base alloys; (5) Development of Procedures for Casting NPR Billets—multiple mold assembly for simultaneous production of three billets; (6) Uranium Rolling Test: Cross Section Shapes and Deformations Produced by the Six-Stand Continuous Mill—changes in rolled uranium rods; and (7) Shearing Uranium Rods to Fuel Core Blanks—machine finishing of uranium rods. G.G.

N65-33170# Watervliet Arsenal, N. Y. Benet Labs.
THE EFFECT OF MICROSTRUCTURE AND AGING CONDITION ON THE FATIGUE CHARACTERISTICS OF THE 18% Ni MARAGING STEELS
J. M. Barranco, R. V. Milligan, and T. E. Davidson May 1965 44 p refs
(WVT-6502; AD-61732D) CFSTI: $1.25

Smooth and notched rotating beam fatigue characteristics at various strength levels are presented over the range of 10^3–10^5 cycles-to-failure for 250 and 300 grade 18% Ni maraging steels and a modified 4330 alloy. Two different heats of each of the maraging steels having large differences in ductility and toughness due to microsegregation are examined. In addition, the effects of under- and over-aging on fatigue properties are also studied. The microstructural segregation in the maraging steel showed no detrimental effect on the smooth or notched fatigue properties even though the ductility and toughness values were greatly reduced. Underaging the maraging steels was found to drastically impair the notched fatigue behavior. No correlation was found between notched fatigue behavior, as expressed by notch strength reduction factor, and the standard engineering mechanical properties of ductility and toughness. Author

N65-33197# Aerojet-General Corp., Sacramento, Calif.
TERNARY PHASE EQUILIBRIA IN TRANSITION METAL–BORON–CARBON–SILICON SYSTEMS. PART I: RELATED BINARY SYSTEMS. VOLUME I: Mo–C SYSTEM Technical Report, 1 Jan.–30 Dec. 1964
Erwin Rudy, Stefan Windisch, and Austin Y. Chang Wright-Patterson AFB, Ohio, AF Mater. Lab., Jan. 1965 177 p refs
(Contract AF 33(615)-1249)
(AFML-TR-65-2, Pt. I, Vol. I; AD-463558)

A complete phase diagram of the system molybdenum–carbon is presented. A thermodynamic model for the description of the phase separation of the Me_2C phases in transition metal–carbon systems has been developed and was semiquantitatively applied to Mo_2C. Literature data on thermodynamic properties of molybdenum carbides have been critically evaluated and data were selected. Apparative techniques for the precise study of phase reactions at high temperatures are described. Author

N65-33199# McDonnell Aircraft Corp., St. Louis, Mo.
EVALUATION OF MOLYBDENUM (TZM) SHEET Quarterly Progress Report No. 3, 9 Dec. 1964–9 Mar. 1965
R. E. Jackson 24 Mar. 1965 26 p
(Contract NOw-64-0456-c)
(BO68-3; AD-460441)

Effort during this third quarter of the TZM molybdenum sheet evaluation was expended on coating and fastener testing and in fabrication of test assemblies. The leading edge assemblies, both simple and compound curved, have been completed and coated. The corrugated test panels and details of the control surface are being fabricated. Results of tests conducted and a review of component fabrication are included in this report. Author

N65-33205# National Academy of Sciences—National Research Council, Washington, D. C. Materials Advisory Board.
COMMITTEE ON BERYLLIUM METALLURGY Fourth Progress Report
L. R. Aronin et al 20 Aug. 1965 45 p refs
(MAB-199-M(4))

Presentation of programs on alloying of beryllium are summarized. Most of the work is on solid solutions (such as Be–Cu), and on Be–Al composites (Lockalloy). The status of subpanel (Analysis, Characterization, Purification, and Test Methods) activities is reported. The decision was made to review and comment on all research programs relating to beryllium at the August 1965 meeting. Author

N65-33210# Bureau of Mines, Albany, Ore. Albany Metallurgy Research Center.
METALLURGY Quarterly Progress Report No. 27, Apr. 1–Jul. 31, 1965
Jun. 1965 38 p refs
(Contract AT(11-1)-599)
(USBM-RC-1199) CFSTI: $2.00

Studies are progressing on tantalum, niobium, and zirconium carbon alloys. The electrode sintering furnace was renovated and relocated. Hafnium carbide castings were evaluated for integrity. Unsatisfactory results were obtained during tensile testing. Later improvements resulted in castings of good quality. The emissivity of cast hafnium carbide was determined. Suggested methods of producing uniform dispersions for thorium alloys were deposition of thorium on the thoria using a thermal decomposition reaction in a fluid bed, and mechanically coating the oxide spheres with an industrial wax which would in turn adhere to thorium. A group of waxes was used to coat the thoria, followed by conventional powder metallurgy methods of producing alloys with a thorium matrix. Equipment and techniques for induction melting of reactive metals in a cold copper crucible were developed. Equipment and

methods were refined to improve composition control of uranium oxycarbides. Tungsten–rhenium castings and ingots were prepared as blanks for extrusion. Attempts to extrude powder metallurgy and arc melted W–25 Re billets were unsuccessful with the extrusion parameters selected. R.N.A.

N65-33236# Massachusetts Inst. of Tech., Cambridge. Metals Processing Lab.
DEFORMATION PROCESSING OF ANISOTROPIC METALS Progress Report, 1 Nov.–31 Dec. 1964
D. H. Avery and W. A. Backofen Jan. 1965 7 p
(Contract NOw-65-0124-d)
(PR-3; AD-463896)

Elevated temperature tensile tests on Zircaloy 4 indicated a very sharp maximum in strain rate sensitivity at or near the alpha–beta transus. Elongation values, for which a maximum of 220% was obtained, correlated with strain rate sensitivity; strain ratio values were high but decreased with increasing temperature. M.W.R.

N65-33239# New York Univ., N. Y. School of Engineering and Science.
DEVELOPMENT OF HIGH DUCTILITY ALPHA–BETA TITANIUM-BASE ALLOYS AT 150,000-180,000 psi YIELD STRENGTH LEVEL Final Report, Jul. 1, 1963–Apr. 30, 1964
H. Margolin and P. A. Farrar [1964] 101 p refs
(Contract N161-25513)
(Rept.-185/64; AD-462891)

The tensile and impact properties have been investigated on a series of 23 alloys whose compositions consisted of modifying two basic alloys, Ti-5Al-2V-2Mo-2Sn and Ti-6Al-3V-1Mo-2Sn. Modifications consisted of additions of Fe + Cu, V, Mo or V + Mo or replacing V by Mo. In the range of strengths from 130–150 000 psi, the most outstanding alloy was the Ti-5Al-2V-2Mo-2Sn. However it was observed that the decrease in 32° F impact properties with increasing yield strength varied from alloy to alloy. The decrease was slower for modifications of this alloy containing Fe and Cu, such as the Ti-5Al-2V-2Mo-2Sn-1Fe-1Cu. Author

N65-33347# Union Carbide Research Inst., Tarrytown, N. Y.
RESEARCH ON PHYSICAL AND CHEMICAL PRINCIPLES AFFECTING HIGH TEMPERATURE MATERIALS FOR ROCKET NOZZLES, VOLUME I Final Report
Patrick N. Walsh Aug. 1965 368 p refs
(Contract DA-30-069-ORD-2787; ARPA Order 34-63)
(AD-468828)

The chemical behavior of refractory materials in corrosive, high temperature gaseous environments was studied by solid-gas reactions, mass spectrometry, and spectroscopy. The relative roles of surface kinetics and gaseous diffusion in determining reaction rates were observed in newly developed apparata under kinetically-controlled conditions, and computer programs were written to evaluate diffusion control. The obtained basic kinetic data were used to predict corrosion rates in operational systems. G.G.

N65-33348# Union Carbide Research Inst., Terrytown, N. Y.
RESEARCH ON PHYSICAL AND CHEMICAL PRINCIPLES AFFECTING HIGH TEMPERATURE MATERIALS FOR ROCKET NOZZLES, VOLUME III Final Report
Richard W. Kebler and S. R. Aspinall Aug. 1965 214 p refs
(Contract DA-30-089-ORD-2787; ARPA Order 34-63)
(AD-468830)

Preparation and purification techniques of high purity refractory carbides, nitrides, and boride specimens were studied by chemical analysis, X-ray determinations of their lattice parameters, and by the shape of the X-ray diffraction lines. Reproducible preparations of self-bonded consolidated bodies were made by hot-pressing or cold-pressing and subsequent sintering. Obtained were high purity powders and consolidated bodies of TiC, ZrC, HfC, NbC, and TaC. Also produced were stochiometric TiN, ZrN, and HfN nitrides with a total impurity contents in the range of 0.5 to 0.7 wt/percent. The preparation and consolidation of refractory diborides TaB_2, NbB_2, ZrB_2, TiB_2, and HfB_2 was highly successful. Self-bonded bodies of these materials were made with better than 95 percent of theoretical density. Skeletal TaC–Ag composites were obtained with transverse rupture strengths of 40 000 to 50 000 psi at 1900° C. A new analytical method was developed to determine boron in the refractory bodies of titanium, zirconium, niobium, and tantalum by pyrohydrolysis. G.G.

N65-33361*# Naval Weapons Lab., Dahlgren, Va.
PLANE STRAIN FRACTURE TOUGHNESS OF 18 Ni (250) AND 18 Ni (200) MARAGING WELDED STEEL PLATE
H. E. Romine Washington, NASA, Sep. 1965 51 p refs
(NASA-CR-302) CFSTI: HC $3.00/MF $0.50 CSCL 11F

Notched slow bend tests on 3/4 inch thick plate welded experimentally to simulate seam and girth welds in a 260 inch solid propellant rocket motor case are adequate to detect low levels of fracture toughness and indicate that TIG welding is preferable to MIG or shorting are methods. Critical flaws will be detectable by current inspection methods. A simplified method for determining K_{Ic} was experimentally verified. Author

N65-33392# Manlabs, Inc., Cambridge, Mass.
THERMOMECHANICAL TREATMENTS APPLIED TO ULTRA-HIGH STRENGTH STEELS Final Technical Report
David Kalish and S. Andrew Kulin Apr. 1965 80 p refs
(Contract NOw-64-0356-c)
(AD-614806)

The response of 9% nickel and 4% cobalt steels to thermomechanical treatments was evaluated with particular emphasis on fracture toughness. Two carbon contents, 0.25 and 0.45%, were studied. The thermomechanical treatments involved austenite deformation processes and strain-tempering processes with either martensite or bainite being the transformation product. The properties of undeformed structures were also measured for comparison purposes. Thermal and strain-tempering treatments applied to 9-4-45 develop two bands of precracked Charpy impact energy versus yield strength, one for martensites and one for bainites. In the yield strength range 200 000 to 340 000 psi the bainites possess substantially higher impact strengths than the martensites at equivalent strength levels. Austenite deformation processes do not improve the impact strength of 9-4-45 for treatments involving 50% deformation. Strain-tempering of the 9-4-25 steel develops yield strengths from 200 000 to 300 000 psi. At these strength levels this steel has higher impact energies than the 0.45% carbon steel. Author

N65-33449# Southwest Research Inst., San Antonio, Tex. Dept. of Electronics and Electrical Engineering.
NONDESTRUCTIVE EVALUATION OF METAL FATIGUE Final Report
Felix N. Kusenberger, Byron E. Leonard, John R. Barton, and W. Lyle Donaldson Mar. 1965 94 p refs
(Contract AF 49(638)-1352)
(AFOSR-65-0981; AD-619685)

Factors which influenced the selection of focused ultrasonic Rayleigh wave techniques for use in the nondestructive evaluation of metal fatigue are included. Methods investigated for generating and focusing Rayleigh waves are presented. The selection of specimen materials and designs are presented, including engineering drawings of the steel and aluminum fatigue specimens. Experimental results obtained from small drilled holes in a number of specimen materials and geometries using surface wave techniques (plane wave) are shown including a number of Polaroid photographs of the reflection signal patterns. Ultrasonic plane wave and magnetic inspection results on steel fatigue specimen No. 18 containing a tiny fatigue crack are given. Many inspection records and surface photographs are also shown. Reproductions of Polaroid photographs of ultrasonic signal patterns obtained while stress cycling an aluminum specimen are shown. Inspection records showing a large increase in signal amplitude corresponding with the development of fatigue damage in the form of a crack are included. X-ray diffraction measurements, using a 0.004-inch diameter collimator, were made in the vicinity of the tip of a small fatigue crack, and the results of these measurements are reported. Author

N65-33460# New Mexico Univ., Albuquerque. Bureau of Engineering Research.
PRELIMINARY STUDY OF PURE SHEAR FRACTURE MODEL
F. D. Ju and J. G. Baker May 1965 44 p refs
(Grant AF-AFOSR-568-64)
(ME-13; AFOSR-65-1195; AD-619305)

A specimen configuration that is expected to yield a near pure shear state of strain (in its critical section throughout the deformation range up to fracture) has been designed. Only qualitative results will be presented in this report; the quantitative results will be presented in another report at the conclusion of the research. Preliminary indications are that the specimen satisfactorily meets the requirements set forth in this report. Author

N65-33471# Metals and Controls, Inc., Attleboro, Mass.
STUDY OF DUCTILE COATING FOR THE OXIDATION PROTECTION OF COLUMBIUM AND MOLYBDENUM ALLOYS First Bimonthly Progress Report, 1 Mar.–30 Apr. 1965
J. F. Clarke and E. H. Girard 30 May 1965 21 p refs
(Contract NOw-65-0340-f)
(AD-619286)

Platinum is being investigated as a ductile, oxidation resistant coating for protection of columbium and molybdenum alloys at temperatures to 3000° F. While its oxidation resistance has been found to be excellent, its value as a protective coating for the given substrate alloys rapidly deteriorates as a result of platinum-substrate alloy interdiffusion. It is the prime concern of this contract, therefore, to develop a barrier to this degrading interdiffusion. Twelve materials have been selected for initial evaluation as potential diffusion barriers. Roll bonding, hot press bonding, electron beam evaporation and chemical vapor deposition techniques are being used for fabrication of composite coating-barrier-substrate test samples. Screening tests will be conducted in flowing air at 2550° F to determine the relative merits of the various coating-substrate combinations. Author

N65-33488# Battelle Memorial Inst., Columbus, Ohio.
STRUCTURAL CHANGES IN HIGH-STRENGTH STEEL ASSOCIATED WITH STRESS CORROSION AND ITS RELATIONSHIP TO DELAYED FAILURE Quarterly Progress Report, 28 Sep.–28 Dec. 1964
D. I. Phalen, D. A. Vaughan, A. B. Tripler, W. K. Boyd, and C. M. Schwartz 27 Jan. 1965 22 p refs
(Contract NOw-64-0267-c)
(QPR-2; AD-462843)

Microscopic and crystal-structure examinations have been made on AISI 4340 steel heat treated to four strength levels, to provide a basis for investigating changes in these materials during stress-corrosion cracking and hydrogen embrittlement. Preliminary studies on stress-corrosion fracture surface reveal two, and possibly three, morphological characteristics that coincide with specific areas in the fracture. Metal-hydrogen reactions that have been studied suggest different behavior for martensite and ferrite. The net result of the metal-hydrogen reaction was found to be an induced compressive stress in the surface. Author

N65-33497# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF NEUTRON RADIATION OF CERTAIN MECHANICAL AND STRUCTURAL PROPERTIES OF AUSTENITIC CHROME NICKEL STEEL
Jiri Cervasek and Jan Kutka 25 May 1965 15 p refs Transl. into ENGLISH from Jaderna Energie (Czechoslovakia), v. 9, no. 11, 1963 p 342–346
(FTD-TT-65-125/1+2; AD-467249)

The change of mechanical and structural properties of 13 kinds of anticorrosive steels of Cr–Ni-type exposed to intergural dose of 1,6.1019 n/cm^2 ($E > 1MeV$) was investigated. The dose was held at a constant value and the chemical composition varied namely in the Cr and Ni content. The strengthening was observed, i.e., yield point, strength and hardness increased and plasticity decreased at the same time. Primary the rate of strengthening is independent on chemical composition, namely on chrome and nickel content, however it depends on the physical condition of steel before the radiation. As far as the alloying elements do not influence the properties in initial condition of steel, they exercise no influence also on the radiation stability. Ferromagnetic induction measurement indicated the decrease of corrosion resistance of austenitic steels by radiation to be negligible. Transient austenitic–ferritic structure steels only show a 0.43–0.72% increase of magnetic phase caused by $\gamma \rightarrow \alpha$ decay. Author

N65-33505*# Franklin Inst., Philadelphia, Pa.
THE EFFECT OF NUCLEATION OF SURFACE SLIP ON THE FLOW AND FRACTURE OF BERYLLIUM Final Report
A. Lawley, J. F. Breedis, and K. V. Snowden Jul. 1965 113 p refs
(Contract NASr-145)
(NASA-CR-64849; F-B2028-1) CFSTI: HC $4.00/MF $0.75 CSCL 11F

Transmission electron microscope studies have been made of the dislocation arrangements in zone-refined Pichiney beryllium oriented for basal or prism slip following fatigue at room temperature. Fatigue modes include reverse bending at 1800 cpm and low frequency (~2 cpm) uniaxial tension or compression cycling. The surface slip structure in band fatigue was examined optically and also by using high resolution silicon monoxide replicas. A persistent slip structure develops to a depth ~6μ in both basal and prism slip orientations and bend fatigue. The persistent markings correspond to closely spaced

depressions or pits on the crystal surface and are parallel to (0001) for basal slip, or (0001) and (0$\bar{1}$10) is prism slip. After prolonged examination in the electron microscope, recovery of the bend fatigue substructure occurs with a significant lowering of the dislocation density. Author

N65-33515# IIT Research Inst., Chicago, Ill.
PROTECTIVE COATINGS FOR TANTALUM-BASE ALLOYS Fourth Quarterly Report, 1 Feb.–30 Apr. 1964
John J. Rausch [1964] 38 p refs
(Contract AF 33(657)-11258)
(IITRI-B6013-12; AD-461064)

This program is concerned with developing protective coating systems for tantalum-base alloys useful in an oxidizing environment at temperatures above 3400° F. Initial effort is directed toward exploring selected metallic, inorganic compound, and composite systems that could serve as the basis for such coating systems. The study is confined to very refractory, thermodynamically stable materials. The results of these investigations have shown that oxidation resistant alloy compositions exist in the hafnium–tantalum binary system. Such materials form an ideal basis for developing protective coatings for tantalum-base alloys. As a consequence, the oxidation behavior of alloys in the binary system, as well as ternary alloys, has been studied in greater detail. The potential of using the higher melting platinum group metals as constituents in coating systems is being investigated. The influence of Zr, Hf, and Y alloying additions on oxidation behavior has been studied along with interaction studies between refractory compounds of Hf or Zr and Ir. Author

N65-33518# General Telephone and Electronics Labs., Inc., Bayside, N. Y.
IDENTIFICATION OF MICROSTRUCTURAL CONSTITUENTS AND CHEMICAL CONCENTRATION PROFILES IN COATED REFRACTORY METAL SYSTEMS Quarterly Report No. 3
D. J. Bracco, P. Lublin, and L. Sama 15 Apr. 1965 58 p ref
(Contract AF 33(615)-1685)
(TR-65-713.9; AD-462883)

The microstructure and chemical concentration profiles in a survey of existing coated refractory metals systems are investigated, both as-coated and under high-temperature oxidizing conditions. The investigation employs a variety of techniques to obtain phase identification and composition data within each system. This report contains the results of electron-probe surveys of Cb base–Si, Cr and Cb base–Si, Ti, Sr systems before and after environmental exposure. Quantitative analysis of base metals and coating raw materials, and qualitative analysis of coatings are reported. Author

N65-33532# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
INFLUENCE OF IMPURITIES ON THE HEAT FRACTURE OF COMMERCIALLY PURE BERYLLIUM [INFLUENCE DES IMPURETES SUR LA FRAGILITE A CHAUD DU BERYLLIUM DE PURETE COMMERCIALE]
José Maria Mallen-Herrero Jul. 1965 101 p refs In French
(CEA-R-2445) CFSTI: HC $4.00/MF $0.75

Brittleness of commercial beryllium at 400 to 600° C was studied. It was found experimentally that the brittleness is closely related to the distribution of iron, aluminum, and silicon as impurities in the beryllium. Thermal treatments were tested which affected the structure of the impurities and resulted in an improvement in the high temperature ductility of the beryllium. Transl. by J.M.D.

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N65-32427* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
CARBON AND GRAPHITE RESEARCH
W. V. Kotlensky and D. B. Fischbach *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 75–81 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

Data were obtained on the structures developed during tensile creep to various elongations at several temperatures. The results show that the same structure is developed at the same strain regardless of test temperature at least above 2500° C. In addition, the structure in the substrate plane is highly anisotropic after moderate amounts of deformation. Optical polarized light micrographs of unetched specimens creep-tested to nominal 10% elongation at three temperatures are shown, and the significance of the structural changes are discussed. Also, electron micrographs of polished and fractured surfaces of glassy carbon specimens are shown, and the significance of these examinations is considered. The electron micrographic results show that the differences in high-temperature mechanical properties of glassy carbon specimens are associated with marked differences in fracture mode. E.E.B.

N65-32428* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FAR INFRARED OPTICAL PROPERTIES OF SOME SPACECRAFT PAINTS
W. M. Hall *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 81–83 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

Spacecraft paints and clear vehicles were examined for spectral reflectance and transmissivity over a broad spectral range from the near ultraviolet to 60 microns in the infrared. Transmittance and reflectance curves for a number of thicknesses of the coating are presented. The transmittance specimens were overlaid on polyethylene film of about 38 micron thickness; the reflectance specimens were sprayed on aluminum. E.E.B.

N65-32487 France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
THE RHEOLOGIE OF POLYMERS AND PLASTIC MATERIALS [RHEOLOGIE DES POLYMERS ET DES MATIERES PLASTIQUES]
B. Persoz *In* AGARD Advan. in Mater. Res. in the NATO Nations 1963 p 223–246 In FRENCH (See N65-32475 21-26) CFSTI: HC $8.35/MF $2.50

Rheological investigation of high-polymers is reported. These polymers are classified either as linear or reticular, and are studied separately with respect to their mechanical properties and methods of measurements. Transl. by J.M.D.

N65-32496 British Ceramic Research Association, Stoke-on-Trent (England).
MECHANICAL PROPERTIES OF COMPOSITE MATERIALS
N. F. Astbury *In* AGARD Advan. in Mater. Res. in the NATO Nations 1963 p 369–390 refs (See N65-32475 21-26)
CFSTI: HC $8.35/MF $2.50

The ceramic is a brittle material and the engineer must take account of this design. The paper examines the implications of the description "brittle", and shows how the behaviour of ceramics in impact, in thermal shock and in the absorption of elastic energy, appears to depend upon a critical strain, which can be assessed as the ratio of a modulus of rupture to Young's modulus. An examination of data on a wide range of ceramic materials shows that this critical strain remains around 0.1 percent, while elastic moduli cover a range of 100 to 1. This strain is much lower than one would expect for an ionic crystal, but is compatible with microcracks of plausible dimensions. This strain is also reported for a true polycrystalline aggregate, where the limit must be set by dislocation density. The essential ceramic problem emerging from this is the question whether one can prescribe, on the basis of solid mechanics, the composition of a ceramic body so that modulus of rupture, Young's modulus and internal friction can be separately controlled. Some observations on the fatigue of ceramic materials are included, and the behaviour of some actual materials in creep and rocket firing tests is recorded.
Author

N65-32545 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DESCRIPTION OF ANISOTROPIC CREEP OF FIBERGLASS
G. I. Bryzgalin *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 316–326 refs (See N65-32506 21-25)

Creep tests were conducted on fiberglass having two mutually perpendicular directions of reinforcement in the form of plates, for determining the deformation properties of the material which was considered to behave as an elastic-orthotropic body with shear creep. Transverse deformations were measured by pneumatic transducers. Deformation-time curves, obtained at constant load, are presented for samples cut from one plate at different angles to one of the directions of reinforcement; and the dependence of creep on the sample orientations is graphically shown. Other graphs pertaining to deformation data are also shown. A fiberglass mathematical model was constructed from the experimental data in such a manner that the equations contain one operator, and in conditions of creep, the deformations are close to the deformations of real material. The behavior of the model under various conditions is determined.
L.S.

N65-32684# General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility.
EFFECTS OF NUCLEAR RADIATION AND VARIOUS ENVIRONMENTS ON A NUMBER OF SELECTED PLASTIC, GLASS-LAMINATE, AND CERAMOPLASTIC MATERIALS Technical Report, 1 Oct. 1963–25 Mar. 1965
P. M. Johnson, J. H. Lewis, and M. R. Self Kirtland AFB, N. Mex., AF Weapons Lab., Jul. 1965 87 p refs
(Contract AF 29(601)-6213)
(FZK-227; AFWL-TR-65-40; AD-618040)

Eight plastic materials were irradiated under various environmental conditions and subsequently tested to determine changes in tensile properties, hardness, and specific gravity. Merlon polycarbonate was irradiated to six gamma dose levels in air at 75° F and two dose levels in a vacuum of approximately 3×10^{-7} torr. Plestar polycarbonate film was irradiated to six dose levels in air at 75° F. The acrylonitrile-butadiene-styrene (ABS) plastics Kralastic MV and SRA received six doses in air at 75° F, six doses in air at 240° F, and two doses in vacuum. Kralastic SR and a glass-reinforced diallyl phthalate were irradiated to three dose levels in air at 75° F and to two doses in vacuum. Supramica 500 ceramoplastic received three doses in air at 75° and 240° F. Maximum gamma dose in air and in vacuum was 2×10^{11} and 3.2×10^{10} ergs/gm(C), respectively. Irradiations were performed with the Ground Test Reactor at the Nuclear Aerospace Research Facility. All materials except the poly(n-vinyl carbazole), diallyl phthalate, and ceramoplastic were severely damaged at the highest doses.
Author

N65-32802# Sandia Corp., Albuquerque, N. Mex.
APPLICATION OF THE POINTED ELECTRODE IN EVALUATING PULSE LIFE OF CASTING RESINS
O. Milton Oct. 1964 18 p refs
(Contract AT(29-1)-789)
(SC-DC-64-1005; Conf.-769-6)

An improved method of testing casting resins to be used for encapsulating pulse transformers or pulse circuits is described. The technique involves casting a needle point electrode in the resin block and counting the number of 200 kv pulses required to break down the material. Actual use of this method indicates that materials judged best by the usual 60-cycle ac test are not necessarily best for pulse applications.
J.M.D.

N65-32886*# California Inst. of Tech., Pasadena. Firestone Flight Sciences Lab.
MECHANICAL PROPERTY OF SOLITHANE 113
E. Betz Jul. 1965 32 p refs
(Grant NsG-172)
(NASA-CR-64711; GALCIT-SM-65-12) CFSTI: HC $2.00/MF $0.50 CSCL 11I

Spring and dashpot model representations were used to study failure under stress of a test material designated Solithane 113. Elements of the model were determined from the relaxation modulus of the material obtained in tests at small strains in tension. A set of equations was derived for stress, strain, and energy responses of linear viscoelastic systems for a wide spectrum of load inputs; these results are presented graphically and are used to compute the mechanical properties of the solithane. The components of complex modulus and complex compliance behavior are plotted as functions of the input frequency. Various strain rate histories and their combinations were investigated and results are plotted for a special case where two strain rates are combined at various ratios. Temperature conditions for isothermal and adiabatic testing of the material are given for sinusoidal strain inputs and graphs are presented for measuring a specimen thickness or an adiabatic temperature increase.
M.W.R.

N65-32923# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
ANNUAL REPORT OF THE JAPANESE ASSOCIATION FOR RADIATION RESEARCH ON POLYMERS, VOLUME 5, 1963–1964
Aug. 1965 327 p refs Transl. into ENGLISH of the publ. "Nippon Hoshasen Kobunshi Kenkyu Kyokai Nempo, v. 5, 1963–1964" (Japan) 254 p
(AEC-TR-6565) CFSTI: $7.00

Studies are reported on radiation-induced thermoluminescence, electrical conductivity of irradiated polymers, passage of electrons through matter, and radiation-induced polymerizations. Theoretical aspects of mass spectrometry, radiation-induced reactions of low molecular weight organic compounds, synthesis of organic compounds by radiation-induced reactions, and studies on pohtochemical changes to radicals are also discussed. Some 23 reports are presented, covering various aspects of this research. An outline of the association's activities is also included.
M.G.J.

N65-33001# Sandia Corp., Albuquerque, N. Mex.
THE CONFIGURATIONAL STABILITY OF TACTIC POLYSTYRENES [UBER DIE STABILITAT DER KONFIGURATION VON TAKTISCHEN POLYSTYROLEN]
Dietrich Braun, Hans Hintz, and Werner Kern 30 Sep. 1964 9 p refs Transl. into ENGLISH from Makromol. Chem. (Heidelberg), v. 62, 1963 p 108–119
(SC-T-64-1638)

The possibility of altering the tacticity of isotactic polystyrene was examined. Neither mechanical disintegration in a ball mill nor chemical degradation with aluminum trichloride in solution affects the tactic structure of polystyrenes. The action of K/Na_2O on isotactic polystyrene yields poly-α-potassium-styrene, the tacticity of which is likewise unchanged, since crystallizable polystyrene is recovered after hydrolysis. Thus tactic polystyrene shows considerably greater stability towards "racemizing" agents than comparable models of low molecular weight. Author

N65-33065*# National Aeronautics and Space Administration, Washington, D. C.
DETERMINATION OF THE GLASS TRANSITION TEMPERATURE OF A PLASTIC MATERIAL FROM THE VARIATIONS IN PENDULAR HARDNESS [DETERMINATION DE LA TEMPERATURE DE TRANSITION VITREUSE D'UNE MATIERE PLASTIQUE, ,PAR LES VARIATIONS DE SA DURETE PENDULAIRE]
Bernard Persoz and Geneviève Grenier Sep. 1965 13 p refs Transl. into ENGLISH from Rech. Aérospatiale (France), no. 99, 1965 p 11–16
(NASA-TT-F-365) CFSTI: HC $1.00/MF $0.50 CSCL 11I

A definition of the glass transition temperature, based on the variation of the pendular hardness (Persoz method) during the transition from the glass-like state to the rubber-like state, is given. The data are applied to four polymers (polystyrenes), and a comparison with other experimental data on the same materials is given. A simple and cheap hardness tester machine is described with which the Brewster coefficient of synthetic resins and other materials can be determined immediately after application of the load. Author

N65-33150# Sandia Corp., Albuquerque, N. Mex.
CORRELATION BETWEEN ELECTRICAL PULSE RESISTANCE AND MECHANICAL SHOCK RESISTANCE FOR FOUR CASTING RESINS
J. B. Allyn [1964] 9 p refs
(Contract AT(29-1)-789)
(SC-DC-64-1001)

The purpose of this study was to see if any correlation does exist between electrical pulse and mechanical shock resistance in four casting resins. The underlying hypothesis of the study was that electrical pulse and mechanical shock resistance are inversely related. The study was carried out by exploding wires within four casting resins, two of them semi rigid, and two somewhat flexible in their static behavior. The extent of fracture, the fracture rate, and evidence of exploding wire confinement were then compared to electrical pulse data. The results of the study were as follows: The two semi rigid materials, which had very high electrical pulse resistance, had very low mechanical shock resistance. The two more flexible materials had low electrical pulse resistance but high mechanical shock resistance. The explanation of the test results is that low shock resistance is connected with rapid energy absorption. It is also connected with rapid relief of the high pressure and temperature produced in a partial breakdown filament. This rapid relief reduces charge density in the filament and perhaps thus reduces the electrical field intensity at the filament tip. Such a result would seem to promote high voltage resistance. Author

N65-33304# General Dynamics/Convair, San Diego, Calif.
THERMOPHYSICAL PROPERTIES OF PLASTIC MATERIALS AND COMPOSITES TO LIQUID HYDROGEN TEMPERATURE (−423°F) Final Report, Feb. 1964–Mar. 1965
Malcolm D. Campbell, Gerald L. O'Barr, James F. Haskins, and Julius Hertz Wright-Patterson AFB, Ohio, AF Mater. Lab., Aug. 1965 99 p refs
(Contract AF 33(657)-9160)
(ML-TDR-64-33, Pt. III; AD-468155)

The primary objectives of this program were to measure the thermophysical properties from −423° F to 75° F of a series of plastics and composites most likely to be used for cryogenic applications. This information is required for use in the design of current and proposed missiles and space vehicles which utilize cryogenic propellants or are exposed to the cryogenic conditions of a space environment. Seven materials were evaluated. These were in addition to seventeen materials evaluated during the first phase of the program. In both phases, thermal expansion, thermal conductivity, and specific heat were measured over the approximate temperature range of −423° F to 75° F. Since many of these materials exhibit directionality because of their composition, thermal conductivity and thermal expansion measurements were made in more than one unique direction. Room temperature mechanical properties, density, resin content and void content were also measured; the variation of density with temperature was calculated from the expansion values. All experimental data was analyzed and correlated with theoretical considerations. Particular emphasis was put on development of a semi-empirical analytical model of the heat conduction in composite materials. Author

N65-33370*# AVCO Corp., Tulsa, Okla.
COMBINED SPACE ENVIRONMENT EFFECTS ON TYPICAL SPACECRAFT WINDOW MATERIALS Final Report, Jun. 1964–Jun. 1965
R. H. Jones Jul. 1965 55 p refs
(Contract NAS9-2939)
(NASA-CR-65142; TR-65-351-F) CFSTI: HC $3.00/MF $0.50 CSCL 11I

Nine samples of prospective Apollo window materials were exposed to a simulated space radiation environment consisting of combined low energy protons (50 kev) and electromagnetic radiation, with wavelengths from 1216 angstroms in the extreme ultraviolet to two microns in the infrared. An accelerated two-week mission was simulated, assuming a solar flare to occur during the period. The purpose of the tests was to determine the optical degradation resulting from such exposure with the damage criterion being the observed change in spectral transmittance. Degradation was found to occur to varying degrees in all materials tested. Spectral transmittance curves of each material, made *in situ*, are presented for several increments of radiation dosage. Author

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N65-32413* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FIRST- AND SECOND-SUM NUMERICAL INTEGRATION
J. D. Anderson *In its* Space Programs Sum. No. 33-37, Vol. IV 30 Jun. 1965 p 17–22 (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

The first and second sum formulas of celestial mechanics are developed in terms of the backward differences and are carried to the seventh order in the differences. Both predictor and corrector formulas are given. Also, the formulas are expressed in terms of antecedant values of the acceleration. It is therefore possible to integrate a set of second order differential equations without resorting to the construction of a difference table. Many of the formulas given are not available in the literature and thus are useful for studies requiring higher order differences than are usually published. The method of generating the formulas is standard and the coefficients can be generated by a computer program to any order of interest. However, the coefficients are computed only within the precision carried in the machine. This has been done for the second sum predictor and corrector to the fifteenth difference and the resulting fromulas have been used to generate the standard planetary ephemerides over the past three years. E.E.B.

N65-32414* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

THE DETERMINATION OF A DENSITY FUNCTION: AN EXERCISE IN THE APPLICATION OF INTEGRAL TRANSFORMS

C. B. Solloway *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 22-23 (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

The probability density function p(r) of the radius vector $r = (x^2 + y)^2$ is determined for a marginal density function g(x) of a two-dimensional distribution, known to be independent in polar coordinates and uniform in the polar angle θ. This problem arose practically in connection with the operational characteristics of a star-tracker device. E.E.B.

N65-32464* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

HADAMARD MATRICES OF ORDER 20

M. Hall, Jr. *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 267-269 ref (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

The work done to show that there are exactly 3 classes of Hadamard matrices of size 20 is described. There are exactly three distinct classes of Hadamard matrices of order 20, if matrices equivalent under permutation of rows or columns or change of sign of rows or columns are considered in the same class. These three classes are labeled class Q, class P, and class N. Class Q contains the matrix derivable from the quadratic residues modulo 10. Class P contains the matrix which can be constructed from GF(9) as a special case of Paley's general construction for orders $2(1 + p^r)$ where p^r is a prime power and $p^r \equiv 1 \pmod 4$. Class N is a new class not previously known. Each of the three classes possesses a symmetric representative, and so each is its own transpose class. E.E.B.

N65-32465* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

FURTHER INVESTIGATIONS OF RANDOM NUMBERS

R. C. Tausworthe *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 269-272 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

Previously a method for the generation of random numbers was presented which contained several conditions placed upon the parameters of generation that were necessary to the analysis of the numbers produced. This article analyzes the question as to the necessity of these limitations which were placed on the parameters. It is concluded that if the parameters are not limited as specified the degree of randomness in the generated sequence is degraded. Random numbers generated by linear recurrence modulo 2; correlation properties, and distribution properties of the theorem are discussed. E.E.B.

N65-32467* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

GENERALIZED BARKER SEQUENCES

S. W. Golomb and R. A. Scholtz *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 274-278 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

A generalized Barker sequence is a finite sequence $\{a_i\}$ of complex numbers having an absolute value 1 and possessing a correlation function $C(\tau)$ satisfying the constraint $|C(\tau)| \leq 1$, $\tau \neq 0$. Classes of transformations leaving $|C(\tau)|$ invariant are exhibited. Constructions for generalized Barker sequences of various lengths and alphabet sizes are given. Sextic Barker sequences are investigated and examples given for all lengths through thirteen. No theoretical limit to the length of sextic sequences has been found. These sequences generalize to polyphase modulated radars the binary Barker sequences used in certain biphase modulated radars for range gating. Author

N65-32551 Joint Publications Research Service, Washington, D. C.

ON MONOTONIC FUNCTIONS OF THE ALGEBRA OF LOGIC

V. K. Korobkov *In its* Probl. in Cybernetics 16 Aug. 1965 p 1-34 refs (See N65-32550 21-08) CFSTI: $7.00

A class of monotonic functions is investigated. The first chapter of this work is devoted to an evaluation of the number of monotonic functions of the algebra of logic depending on n variables $x_1, x_2, \ldots, x_n$. It is shown that the monotonic functions of the variables $x_1, x_2, \ldots, x_n$ form a free distributive structure with n generatrices. The problem of synthesis of systems from functional elements is investigated in the second chapter for an arbitrary monotonic function of the algebra of logic depending on the variables $x_1, x_2, \ldots, x_n$. The last chapter is devoted to the question if some monotonic function is given by the operator A_f calculated for an arbitrary point, how is the table of values of the monotonic function determined by the minimal number of references to the operator A_f. E.E.B.

N65-32552 Joint Publications Research Service, Washington, D. C.

ON AN ASYMPTOTIC PROCEDURE FOR SOLUTION OF THE CHARGE PROBLEM

T. N. Kruglova *In its* Probl. in Cybernetics 16 Aug. 1965 p 35-57 refs (See N65-32550 21-08) CFSTI: $7.00

A set E_n of vertices of an n-dimensional unit cube is considered. At the vertices of the cube S of the same type charged particles are placed. Under the effect of the forces of repulsion these particles will be displaced with respect to the vertices of the cube to some stable state. The problem consists in finding the stable states of S particles which in the given model is equivalent to finding in the class of sets of the vertices of the cube E_n the power S of the set with minimal energy. A procedure is proposed which permits for the series $\{M_n\}$ of sets M_n of power S_n asymptotic evaluation of the energy both from above and below. In some cases this procedure permits establishing of the asymptotic energies. Also, two series of the sets for the case $S_n = [2^n/(n + 1)]$ are constructed. The first of these has an energy asymptote just as the series $\{P_n^0\}$ of sets with minimal energy; the second has the asymptote which differs from the asymptote for the series $\{Q_n^0\}$ of sets with maximal energy by no more than two times. E.E.B.

N65-32553 Joint Publications Research Service, Washington, D. C.

ON POWERS OF SETS OF PRE-COMPLETE SETS OF CERTAIN FUNCTIONAL SYSTEMS RELATED TO AUTOMATA

V. B. Kudryavtsev *In its* Probl. in Cybernetics 16 Aug. 1965 p 58–96 refs (See N65-32550 21-08) CFSTI: $7.00

Problems are investigated which are related to the problem of completeness of automata. In engineering practice it is frequently expedient to construct automata with a given behavior beginning with some set of elementary automata. The problem of the possibility of the construction of an automaton with arbitrary given behavior reduces to an explanation of whether systems are contained among the permissible systems which realize an automaton of interest, that is, whether the initial system of automata is complete. The so-called finite automata are considered. E.E.B.

N65-32557 Joint Publications Research Service, Washington, D. C.
ON AUTOMATIC DEVELOPMENT OF SITUATION EVALUTION FOR A GAME OF X'S AND O'S
S. L. Ambaryan, Kh. K. Brutyan, and T. M. Ter-mikaelyan *In its* Probl. in Cybernetics 16 Aug. 1965 p 178–190 ref (See N65-32550 21-08) CFSTI: $7.00

A method was previously described fo a game of X's and O's between a man and a machine for which each free square of the game board had some value and the machine as its next move selected the square with the maximum value. In doing this the rule for working out the values, and also the values to be used in the evaluations were communicated to the machine in finished form. In this article these rules are also constructed, but in contrast to the preceding work, the values of the evaluations are not known in advance and the machine itself determines them in the process of its learning. The game is carried out on a field of 64 squares. One of the partners selects the sign X and the other the sign O. The game consists in a series of moves which are taken in turn by the opponents. Each move consists in occupying one of the free squares of the game field with a playing symbol. One of the players begins the game which is finished when five squares are formed into a line series having the same sign. The player which has this sign is considered to be the winner. E.E.B.

N65-32563 Joint Publications Research Service, Washington, D. C.
ON ADDITIVE CHAINS OF NUMBERS
A. M. Il'in *In its* Probl. in Cybernetics 16 Aug. 1965 p 325–330 refs (See N65-32550 21-08) CFSTI: $7.00

The series of integers $1 = a_0, a_1, \ldots, a_r = n$ is considered such that $a_k = a_i + a_j$, $0 \leq i, j < k$, $k = 1, 2, \ldots, r$. Let $l(n)$ be the least r (the length of the chain) for which the last term of the chain $a_r = n$ where n is a positive whole number. The problem of finding the value of $l(n)$ arises when trying to find the least number of mulhplications required to bring some number to the power n. In this article it is shown that the evaluation of

$$l(n) \leq \log_2 n + C_1 \frac{\log_2 n}{\log_2 \log_2}$$

cannot be improved for all n simultaneously. More exactly it is shown that for some finite series of positive whole numbers n the following inequality is fulfilled

$$l(n) \geq \log_2 n + C_3 \frac{\log_2 n}{\log_2 \log_2 n}.$$

E.E.B.

N65-32591 Chicago Univ., Ill. Inst. for Computer Research.
ON THE EXTENSION AND THE SOLUTION OF NONLINEAR OPERATOR EQUATIONS
W. V. Petryshyn *In its* ICR Quart. Rept., No. 5 1 May 1965 38 p refs (See N65-32588 21-08)

A procedure for the construction of solvable extensions of densely defined nonlinear operators in Hilbert space is presented. Convergence of a simple iterative method for the solution of strongly H_0-monotonic operator equations was used to find the approximate iterative solution for a nonlinear elliptic boundary value problem of the second order. G.G.

N65-32651 Joint Publications Research Service, Washington, D. C.
THE STANDARD TYPE OF CONSTANT COEFFICIENT LINEAR PARTIAL DIFFERENTIAL EQUATIONS OF THE SECOND ORDER, TWO VARIABLES, AND TWO UNKNOWN FUNCTIONS TYPE
Lo-keng Hua, Tzu-ch'ien Wu, and Lin Wei *In its* Transl. on Communist China's Sci. and Tech., No. 203 9 Aug. 1965 p 74–80 refs (See N65-32650 21-34) CFSTI: $5.00

It is shown that a linear partial differential equation of the second order, with two-column two-row real number matrices, can be converted into a standard type of constant coefficient. Equal-value relationship is explained by calculations of the three necessary conversions: (1) linear transformation of variables, (2) linear combination of equations, and (3) linear transformation of unknown functions. A characteristic quartic-type standard equation and a hyperelliptic-type equation are developed. M.W.R.

N65-32681# Lockheed Missiles and Space Co., Sunnyvale, Calif.
SOLUTION OF INTEGRAL EQUATIONS BY THE METHOD OF STRIPS
G. N. Polozhii and P. I. Chalenko [1965] 18 p refs Transl. into ENGLISH from Vopr. Mat. Fiz. i Teor. Funktsii, Akad. Nauk Ukr. SSR, (Kiev), 1964 p 124–144

A numerical technique for solving integral equations is presented. The technique, named the method of strips, is a special combination of three known methods: the methods of simple iteration, finite differences, and approximation of the kernel. The method is described and illustrated with numerical examples in connection with the Fredholm integral equation of the second type. J.M.D.

N65-32685# Washington Univ., Seattle. Dept. of Mathematics.
LINEAR COMPLETELY INTEGRABLE PARTIAL DIFFERENTIAL EQUATIONS
Harold H. Johnson Jun. 1965 9 p refs
(Contract Nonr-477(15))
(TR-26; AD-617277)

Completely integrable systems of partial differential equations which are linear are studied as a vector space of commuting matrices. When one is diagonalizable they are all diagonalizable. Solutions may be expressed in exponential matrix form. Author

N65-32697# RAND Corp., Santa Monica, Calif.
ON A NEW APPROACH TO THE NUMERICAL SOLUTION OF A CLASS OF PARTIAL DIFFERENTIAL INTEGRAL EQUATIONS OF TRANSPORT THEORY
Richard Bellman and Robert Kalaba Jul. 1965 14 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4667-PR; AD-617909)

In this memorandum, the authors show how to approximate a non-linear partial differential integral equation by a system of ordinary differential equations. A table of necessary constants is provided, and the results of a test calculation on an equation of radiative transfer in a spherical shell are described. Author

N65-32727*# National Aeronautics and Space Administration, Washington, D. C.
SOLUTION OF SYSTEMS OF NONLINEAR EQUATIONS BY THE METHOD OF DIFFERENTIATION WITH RESPECT TO A PARAMETER [K RESHENIYU SISTEM NELINEYNYKH URAVNENIY METODOM DIFFERENTSIROVANIYA PO PARAMETRU]
M. N. Yakovlev Sep. 1965 10 p refs Transl. into ENGLISH from Z. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 4, 1964 p 146–149
(NASA-TT-F-254) CFSTI: HC $1.00/MF $0.50 CSCL 12A

A method of solving systems of nonlinear equations through the use of a dummy parameter is presented, and is substantiated by various theorems on the existence of unique solutions. In this method, the parameter is defined on the real line between zero and unity, and is introduced into the equations in such a way that differentiation with respect to the parameter reduces the problem to that of solving the Cauchy problem for differential equations. J.M.D.

N65-32728*# National Aeronautics and Space Administration, Washington, D. C.
THE PROBLEM OF THE CONVERGENCE OF THE METHOD OF INTEGRAL RATIOS [K VOPROSU O SKHODIMOSTI METODA INTEGRAL'NYKH SOOTNOSHENIY]
V. V. Bobkov Sep. 1965 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Belorussk. SSR, v. 8, no. 1, 1964 p 5–9
(NASA-TT-F-261) CFSTI: HC $1.00/MF $0.50 CSCL 12A

The method of integral ratios for obtaining approximate solutions to partial differential equations is applied to the case where the differential equations are of the hyperbolic type. In this method, the domain of integration is divided by straight lines into N strips, such that the approximation is reduced to N consecutively solvable Cauchy problems. To evaluate the convergence of the method, a formula is derived for estimating the error due to approximation. J.M.D.

N65-32733# Boeing Scientific Research Labs., Seattle, Wash.
THE LIE ALGEBRA OF VISUAL PERCEPTION
William C. Hoffman Apr. 1965 55 p refs *Its* Math. Note No. 408
(D1-82-0432)

The familiar perceptual constancies of image location in the field of view, image orientation, size constancy, shape constancy, binocular distortion, and motion, have their natural mathematical expression in terms of Lie groups of transformations over the visual manifold. If Lie's three fundamental theorems are to be satisfied, three additional perceptual invariances must also be present: time, efferent binocularity, and what apparently constitutes some sort of circulating memory in space-time. This Lie algebra of visual perception admits ready explanations for the following visual phenomena: the developmental sequence of infant vision; orthogonal after-images; after-effects of seen-movement; the spiral after-effect and the spiral images sometimes evoked under flicker; reading reversals; and the visual analogue of the Fitzgerald contraction. The theory also predicts certain new complementary (orthogonal) after-images, the existence of which have been verified experimentally. Author

N65-32738# Rhode Island Univ., Kingston.
RAYLEIGH WAVES AT THE CONTINENTAL MARGIN Scientific Report No. 6
Julius Kane 10 Jun. 1965 35 p refs
(Contract AF 19(628)-319; ARPA Order 180–62; ARPA Order 292–62)
(AFCRL-65-454; AD-618920)

In this report, the first of a series on the analytic continuation of wave functions past discontinuities, we introduce an elementary procedure for the solution of problems involving the diffraction of vector fields. In particular, the report discusses the propagation of Rayleigh waves incident obliquely upon the continental margin. The crustal layering on either side of the coastline is modeled mathematically as a two-part boundary layer in such a fashion that the relevant reflection and transmission coefficients emerge as elementary algebraic expressions. The procedure that permits such a solution to be found is to introduce a diffraction analogue of the well-known procedure in electrical engineering: replace a transmission line network by a lumped parameter equivalent in a specified frequency or wave number domain. Author

N65-32797# Purdue Univ., Lafayette, Ill. Dept. of Statistics.
MULTIPLE DECISION PROCEDURES FROM AN EMPIRICAL BAYES APPROACH
John J. Deely Jul. 1965 89 p refs *Its* Mimeograph Ser. No. 45
(Contracts Nonr-1100(26); AF 33(657)-11737)
(AD-618525)

A decision theoretic framework is used in selecting the "best" alternative or a subset containing the "best" alternative under specified loss functions; and procedures are derived to minimize the overall expected loss or the Bayes risk. Basic definitions and notations are given, and the subset problem is shown to be closely related to the selection of the "best" problem. A theorem is proved relating empirical Bayes procedure to the Bayes procedure with respect to G; Bayes procedures are found for the cases in which the *a priori* distribution is normal, uniform, beta, and gamma. Another theorem is used to derive procedures for selecting the "best" for normal, Poisson, and form $\theta^x g(x)h(\theta)$ densities. The results are called non-parametric since each G_1 is assumed to possess finite absolute mean. M.W.R.

N65-32820# Stanford Univ., Calif. Stanford Linear Accelerator Center.
THE NATURAL COORDINATE SYSTEM FOR STUDYING VECTOR PROBLEMS
E. L. Chu Jun. 1965 48 p refs
(Contract AT(04-3)-400)
(SLAC-46) CFSTI: $3.00

A natural coordinate system is devised for studying vector problems such as determination of dynamic properties of electron and ion beams moving through electric and magnetic fields. Natural coordinates are those which are measured with reference to vector lines. In particular, a curvilinear coordinate system is developed which has a curved nonplanar vector line for its coordinate axis. This system enlarges the range of applications of Bjorgum's method for analyzing vector problems in mathematical physics. J.M.D.

N65-32861# North Carolina State Coll., Raleigh. Dept. of Mathematics.
CLOSEST PACKING OF EQUAL SPHERES AND RELATED PROBLEMS
Michael Allan Blackledge (M.S. Thesis) 1965 51 p refs
(AD-617283)

The problem of determining the closest possible packing of equal spheres is investigated. First the two-dimensional problem of determining the closest packing of circles in a plane is considered, based on the lattice concept. Then the analogous problem of packing spheres in Euclidean three-space is investigated, using as a transition between the two problems the

sphere cloud concept of L. Fejes Toth. In a related problem, two proofs are presented showing that it is impossible for thirteen spheres of equal size to be in contact with a fourteenth sphere. The first proof used the points of contact to form a network; the second used the concept of central projection. Another problem is presented which generalizes the idea of determining the number of (N+1)-vertex figures in N-space. The vertices are chosen from given points on given intersecting lines, under the restriction that no N lines lie in the same (N−1)-space. A solution is presented and compared with a previously published one. M.R.W.

N65-32863# Massachusetts Inst. of Tech., Cambridge.
A CONTINUOUS KIEFER-WOLFOWITZ PROCEDURE FOR RANDOM PROCESSES
David J. Sakrison 26 Mar. 1963 10 p refs Sponsored in Part by the Army, AFOSR, and ONR
(AD-617363)

The Kiefer-Wolfowitz procedure for determining the parameter values which minimize an arbitrary multivariate random variable is generalized. The variable is now considered to be an ergodic random process, so that the minimization is done by sampling along a continuous time scale rather than by making independent observations at different parameter values. The advantage of this generalization lies in the fact that the procedure can be mechanized with simple analog computation components. The hypotheses of the theorems presented here are chosen from the standpoint of applicability to certain communication and data processing problems. J.M.D.

N65-32896# Lockheed Missiles and Space Co., Sunnyvale, Calif.
A NON-LINEAR OPTIMUM STOCHASTIC CONTROL PROBLEM
Charlotte Striebel Aug. 1965 31 p refs
(LMSC-TR-6-75-65-47)

The problem considered is that of optimum control of a vector-valued dynamic system with white noise driving functions. The covariance matrices of the white noise processes and the coefficients (time varying) of the dynamic system and of the observation equation are all assumed to be known. The loss function is a linear combination of the square of a one-dimensional final miss distance and the integral over time of the absolute value of the control vector. By attacking the discrete control problem it is shown that the optimum control is a function only of the "best" estimate of the final miss and that control is to be applied in such a way that this estimate remains within a certain boundary. Thus, the optimum control problem is reduced to that of determining this boundary. For the discrete case, recursion equations are given by which the boundary can be computed. By formally passing to the continuous case, under certain regularity conditions, it is shown that this boundary is the solution to a free boundary problem for the heat equation. Author

N65-32902# White Sands Missile Range, N. Mex. Electro-Mechanical Labs. Div.
AN INTRODUCTION TO LEAST SQUARES AND ORTHOGONAL POLYNOMIALS USING VECTOR METHODS Internal Memorandum No. 1
Patrick L. O'Dea Nov. 1964 20 p refs
(AD-465582)

For discrete data the conditions for a best approximation in the least squares sense by a continuous function are derived in a vector space with the aid of dyadics. Some advantages of orthogonal polynomials in curve fitting are demonstrated. Coefficients of some Gram Polynomials are provided in the appendix. Author

N65-32964*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
ONE-DIMENSIONAL NUMERICAL ANALYSIS OF THE TRANSIENT RESPONSE OF THERMAL PROTECTION SYSTEMS
Robert T. Swann, Claud M. Pittman, and James C. Smith Washington, NASA, Sep. 1965 48 p refs
(NASA-TN-D-2976) CFSTI: HC $2.00/MF $0.50 CSCL 12A

Differential equations governing the transient response of thermal protection systems to a hyperthermal environment are presented. These equations are expanded into finite-difference equations which are suitable for numerical solution. The equations provide for three layers of different materials, the first two of which may have moving boundaries. Concentrated heat sinks, such as metallic structures, may be located at the back surfaces of the second or third layers or of both layers. The analysis was developed primarily for charring ablators but is also applicable to impregnated ceramic, subliming, and heat-sink thermal protection systems. The principal difficulty encountered in numerical analysis of charring ablators is the extensive computer time required to obtain solutions. Provision is made in the numerical equations to introduce options which reduce computer time. The errors resulting from these options under various conditions are discussed. Good agreement is obtained between numerical results and exact solution. Author

N65-32970*# National Aeronautics and Space Administration, Washington, D. C.
EXPANSION OF POLYNOMIALS IN BESSEL OPERATORS [RAYLOZHENIYE MNOGOCHLENA OT OPERATOROV BESSELYA]
S. I. Osipov Sep. 1965 16 p refs Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 4, 1964 p 149–155
(NASA-TT-F-255) CFSTI: HC $1.00/MF $0.50 CSCL 12A

The problem of expanding operators coinciding with Bessel operators or with operators of similar structure is examined, and equations for expanding a polynomial with arbitrary constant coefficients in a Bessel operator are given. Formulas are also presented for applying this expansion to ordinary linear differential equations. M.G.J.

N65-33064* Southern Illinois Univ., Carbondale.
ON THE NUMERICAL REPRESENTATION OF THE GENERAL SOLUTION OF SYSTEMS OF ORDINARY DIFFERENTIAL EQUATIONS
Robert Silber *In* NASA. Marshall Space Flight Center Studies in the Fields of Space Flight and Guidance Theory 12 Jul. 1965 p 485-497 refs (See N65-33050 21-30) CFSTI: HC $7.88/MF $2.50

Discussed are numerical procedures to obtain the values of partial derivates for the set of function

$$Y_i(t,\tau,\eta_1,\eta_2,\ldots\eta_n), i = 1,2,\ldots,n,$$

where the functions Y_i will be analytic at a selected point and will therefore be expressible in Taylor's series in n = 2 variables. The values can be obtained through any pre-specified order, and a description of the salient points of this method is given in detail. G.G.

N65-33070# Los Alamos Scientific Lab., N. Mex.
A SIMPLE METHOD FOR FINDING THE ZEROS OF POLYNOMIALS, BASED ON d'ALEMBERT'S LEMMA
Zane C. Motteler 25 Aug. 1965 24 p refs
(Contract W-7405-ENG-36)
(LA-3355) CFSTI: $2.00

A method for approximating the roots for a polynomial equation on an electronic digital computer is described. The method is based on d'Alembert's Lemma of algebra, which states that the absolute value of a polynomial assumes a minimum if and only if it is zero. Comparison of the method with other techniques for solving polynomial equations leads to the conclusion that, in addition to simplicity, the new method offers timing and accuracy quite comparable to those of other methods coded with the same precision and sophistication.
Author

N65-33075# Grenoble Univ. (France). Fourier Inst.
ANNALS OF THE FOURIER INSTITUTE. VOLUME XV, NUMBER 1: INTERNATIONAL CONFERENCE ON THE THEORY OF THE POTENTIAL [ANNALES DE L'INSTITUT FOURIER. TOME XV, FASCICULE 1: COLLOQUE INTERNATIONAL SUR LA THEORIE DU POTENTIEL]
M. Brelot, C. Chabauty, J. Dieudonne, J. L. Koszul, L. Neel, ed. et al 1965 315 p refs In FRENCH and ENGLISH Conf. held at Paris-Orsay, France, 22–26 Jun. 1964; Sponsored by Centre Natl. de la Rech. Sci. CFSTI: HC $7.00/MF $1.75

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6. THE MINIMAX THEOREM AND THE THEORY OF CLOSED POTENTIAL B. Fuglede (Copenhagen Univ.) p 65–87 refs (See N65-33081 21-19)

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10. PROPERTIES OF SUPERHARMONIC FUNCTIONS IN AN AXIOMATIC THEORY OF POTENTIAL H. Bauer (Hamburg Univ.) p 137–154 refs (See N65-33085 21-19)

11. STUDY COMPARING TWO TYPES OF TAPERING M. Brelot (Paris Univ.) p 155–168 refs (See N65-33086 21-19)

12. THE THEOREMS OF RENEWAL C. S. Herz (Cornell Univ.) p 169–187 refs (See N65-33087 21-19

13. THE DIRICHLET PROBLEM FOR THE SECOND ORDER ELLIPTIC EQUATIONS WITH DISCONTINUOUS COEFFICIENTS G. Stampacchia (Pisa Univ.) p 189–157 refs (See N65-33088 21-19)

14. COMPLETION PRINCIPLE OF MAXIMUM AND CONTRACTIONS J. Deny (Paris Univ., Orsay) p 259–271 refs (See N65-33089 21-19)

15. MARTIN BOUNDARY AND POSITIVE SOLUTIONS OF SOME BOUNDARY VALUE PROBLEMS E. B. Dynkin (Moscow State Univ.) p 275–282 refs (See N65-33090 21-19)

16. AXIOMATIC THEORY OF HARMONIC FUNCTIONS. NON-NEGATIVE SUPERHARMONIC FUNCTIONS N. Boboc, C. Constantinescu, and A. Cornea (Acad. R. P. R.) p 283–312 refs (See N65-33091 21-19)

N65-33076 Cornell Univ., Ithaca, N. Y. Dept. of Mathematics.
THE THEORY OF POTENTIAL AND THE RECURRENT PROCESSES [LA THEORIE DU POTENTIEL ET LES PROCESSUS RECURRENTS]
G. A. Hunt *In* Grenoble Univ. Ann. of the Fourier Inst., Vol. XV, No. 1 1965 p 3–12 refs In FRENCH (See N65-33075 21-19) CFSTI: HC $7.00/MF $1.75

The theory of potential and recurrent processes is discussed in terms of the Markov process which underlies it. A summary of the research done by Orey, Kemney and Snell, and Spitzer and Kesten is provided, in addition to a brief bibliography.
Transl. by G.A.L.

N65-33077 Kyoto Univ. (Japan). Dept. of Mathematics.
TRANSFORMATION OF MARKOV PROCESSES BY MULTIPLICATIVE FUNCTIONALS
Kiyosi Ito and Shinzo Watanabe *In* Grenoble Univ. Ann. of the Fourier Inst., Vol. XV, No. 1 1965 p 13–30 refs (See N65-33075 21-19) CFSTI: HC $7.00/MF $1.75

A method for transforming Markov processes by multiplicative functionals is presented. The α-subprocess of a Markov process is defined and constructed, given the multiplicative functional α_t. Details on this transformation include: a historical summary of the construction, the factorization theorem for the positive supermartingale, the factorization theorem for the multiplicative functional, the α-subprocess construction itself, some interesting examples and special cases, and the definition of the α-subprocess of a Hunt process X_t.
G.A.L.

N65-33078 Paris Univ. (France). Henri Poincare Inst.
RELATIONSHIPS BETWEEN THE MARTINGALE AND ERGODIC THEORIES [RELATIONS ENTRE LA THEORIE DES MARTINGALES ET LA THEORIE ERGODIQUE]
Jacques Neveu *In* Grenoble Univ. Ann. of the Fourier Inst., Vol. XV, No. 1 1965 p 31–42 refs In FRENCH (See N65-33075 21-19) CFSTI: HC $7.00/MF $1.75

A unification of the rapid convergence, martingale vectorial, and ergodic theorems is presented. A demonstration of these theorems following a common method is discussed, including several simplifications and variations to the demonstration. It is shown that the Ionescu Tulcea theorem, generalizing the theorem of decreasing martingales, can be considered as a special limit case of an ergodic theorem.
Transl. by G.A.L.

N65-33079 Kansas Univ., Lawrence. Dept. of Mathematics.
BESSEL POTENTIALS [POTENTIELS BESSELIENS]
Nachman Aronszajn *In* Grenoble Univ. Ann. of the Fourier Inst., Vol. XV, No. 1 1965 p 43–58 refs In FRENCH (See N65-33075 21-19) CFSTI: HC $7.00/MF $1.75

A review of the properties of certain classes of Bessel potentials in R^n is presented. The explicit definitions of these classes are given, rather than their representations as potentials. Restrictions for certain sub-sets of R^n are studied, notably those for k-dimensional hyperplanes and open sub-sets. The question of differentiable sub-class restrictions is not considered.
Transl. by G.A.L.

N65-33080 Uppsala Univ. (Sweden). Dept. of Mathematics.
MAXIMAL FUNCTIONS AND CAPACITIES
Lennart Carleson *In* Grenoble Univ. Ann. of the Fourier Inst., Vol. XV, No. 1 1965 p 59–64 refs (See N65-33075 21-19) CFSTI: HC $7.00/MF $1.75

For functions f(x) whose Fourier coefficients are such that the sum of the weighted squared coefficients is finite, the capacity is evaluated for the series where the maximal function for f(x) has a certain lower bound. J.M.D.

N65-33081 Copenhagen Univ. (Denmark). Faculty of Sciences.
THE MINIMAX THEOREM AND THE THEORY OF CLOSED POTENTIAL [LE THEOREME DU MINIMAX ET LA THEORIE FINE DU POTENTIEL]
Bent Fuglede *In* Grenoble Univ. Ann. of the Fourier Inst., Vol. XV, No. 1 1965 p 65–87 refs In FRENCH (See N65-33075 21-19) CFSTI: HC $7.00/MF $1.75

The theorem of minimax and the theory of closed potential are considered. It is shown that for every semi-continuous kernel, the capacity of a compact set is equal to a dual quantity, the contents. This theorem is equivalent to an extension of the theorem of minimax in the theory of games. Included are discussions of the existence of an optimal measure for the contents of a compact; the problem of altering the capacity; quasi-open or quasi-closed sets and quasi-continuous functions; the characterization of quasi-continuous functions having a quasi-limit of 0 to infinity; and the interior and exterior capacity and the contents. A brief bibliography is included.
Transl. by G.A.L.

N65-33082 Strasbourg Univ. (France). Dept. of Mathematics.
ERGODIC THEORY AND POTENTIALS [THEORIE ERGODIQUE ET POTENTIELS]
Paul-André Meyer *In* Grenoble Univ. Ann. of the Fourier Inst., Vol. XV, No. 1 1965 p 89–102 In FRENCH (See N65-33075 21-19) CFSTI: HC $7.00/MF $1.75

It is shown that a maximal ergodic lemma, used by A. Brunel in the demonstration of the ergodic theorem of Chacón and Ornstein, is related to J. Deny's theory of elementary kernels. This lemma can be used to obtain the results of Chacón's theory without the difficulties enoucntered in other methods. Transl. by B.A.L.

N65-33083 Mokobodzki (Gabriel), Paris (France).
INTEGRAL REPRESENTATION OF THE SUPERHARMONIC FUNCTIONS USING REDUCED FORMS [REPRESENTATION INTEGRALE DES FONCTIONS SURHARMONIQUES AU MOYEN DES REDUITES]
Gabriel Mokobodzki *In* Grenoble Univ. Ann. of the Fourier Inst., Vol. XV, No. 1 1965 p 103–112 refs In FRENCH (See N65-33075 21-19) CFSTI: HC $7.00/MF $1.75

The integral representation of superharmonic functions using reduced forms is considered in a simplified way under general conditions. A direct method of obtaining the integral representation of positive superharmonic functions on a convex cone, using the first three axioms of Brelot, is presented. It is also shown that within the axiomatic system of Bauer, the convex cone of superharmonic positive functions is measurable and barely complete. Transl. by G.A.L.

N65-33084 Institute for Advanced Study, Princeton, N. J.
SOME CLASSICAL FUNCTION THEORY THEOREMS AND THEIR MODERN VERSIONS
J. L. Doob *In* Grenoble Univ. Ann. of the Fourier Inst., Vol. XV, No. 1 1965 p 113–135 refs (See N65-33075 21-19) CFSTI: HC $7.00/MF $1.75

Some significant results of cluster value theory, in so far as they involve the fine topology of superharmonic, harmonic, and meromorphic functions at the boundary of a half-space of definition and at an isolated singularity, are presented. A Hardy–Littlewood inequality for positive subharmonic functions defined on an arbitrary Green space of dimensionality $N \geq 2$ is discussed, in both probabilistic and non-probabilisitic language. G.A.L.

N65-33085 Hamburg Univ. (West Germany).
EXTREME PROPERTIES OF SUPERHARMONIC FUNCTIONS IN AN AXIOMATIC THEORY OF THE POTENTIAL [PROPRIETES FINES DES FONCTIONS HYPERHARMONIQUES DANS UNE THEORIE AXIOMATIQUE DU POTENTIEL]
Heinz Bauer *In* Grenoble Univ. Ann. of the Fourier Inst., Vol. XV, No. 1 1965 p 137–154 refs In FRENCH (See N65-33075 21-19) CFSTI: HC $7.00/MF $1.75

An axiomatic theory of harmonic functions which is a generalization of Brelot's theory is considered. The theory is applied to equations containing parabolic second order partial derivatives. Absorbing sets, and some new results concerning polar sets, are discussed. Both strong and weak thin sets are studied, in addition to Brelot's convergence theorem and its consequences. Transl. by G.A.L.

N65-33086 Paris Univ. (France). Henri Poincare Inst.
COMPARATIVE STUDY OF TWO TYPES OF TAPERING [ETUDE COMPAREE DES DEUX TYPES D'EFFILEMENT]
Marcel Brelot *In* Grenoble Univ. Ann. of the Fourier Inst., Vol. XV, No. 1 1965 p 155–168 refs In FRENCH (See N65-33075 21-19) CFSTI: HC $7.00/MF $1.75

Two types of tapering are interpreted and compared: internal tapering and minimal tapering. A statistical comparison is made in terms of a classical case, and applications as well as an axiomatic extension of the comparison are discussed. A brief bibliography is included. Transl. by G.A.L.

N65-33087 Cornell Univ., Ithaca, N. Y. Dept. of Mathematics.
THE THEOREMS OF RENEWAL [LES THEOREMES DE RENOUVELLEMENT]
Carl S. Herz *In* Grenoble Univ. Ann. of the Fourier Inst., Vol. XV, No. 1 1965 p 169–187 refs (See N65-33075 21-19) CFSTI: HC $7.00/MF $1.75
(Grant NSF GP-1645)

Renewal theorems are demonstrated and discussed in detail. Presentation is made of a harmonic analysis of generalized LaPlacians, an existence theorem, and the renewal theorem for a recurring case. Transl. by G.A.L.

N65-33088 Pisa Univ. (Italy). Dept. of Sciences.
THE DIRICHLET PROBLEM FOR THE SECOND ORDER ELLIPTIC EQUATIONS WITH DISCONTINUOUS COEFFICIENTS [LE PROBLEME DE DIRICHLET POUR LES EQUATIONS ELLIPTIQUES DU SECOND ORDRE A COEFFICIENTS DISCONTINUS]
Guido Stampacchia *In* Grenoble Univ. Ann. of the Fourier Inst., Vol. XV, No. 1 1965 p 189–257 refs In FRENCH (See N65-33075 21-19) CFSTI: HC $7.00/MF $1.75
(Grant AF-EOAR-65-42)

Dirichlet's problem for second order elliptical equations with discontinuous coefficients is considered. Included is a maximum principle for weak solutions, local majorations, a family of sub-sets of Ω, the Harnack inequality, and the Green function. A detailed bibliography is included. Transl. by G.A.L.

N65-33089 Paris Univ., Orsay (France). Dept. of Sciences.
COMPLETION PRINCIPLE OF MAXIMUM AND CONTRACTIONS [PRINCIPE COMPLET DU MAXIMUM ET CONTRACTIONS]
Jacques Deny *In* Grenoble Univ. Ann. of the Fourier Inst., Vol. XV, No. 1 1965 p 259–271 refs In FRENCH (See N65-33075 21-19) CFSTI: HC $7.00/MF $1.75

A discussion of the completion principle of maximum and of contractions is presented. It is shown that the contraction module is workable if and only if the principle of domination is satisfied, and that normal contractions are workable if and only if the complete principle of normal maximations is satisfied. In the case of functional space invariant under translations of the Abelien group, it is shown that all the normal contractions operate in the same way that the contraction module operates.
Transl. by G.A.L.

N65-33090 Moscow State Univ.(USSR). Inst. of Mathematics.
MARTIN BOUNDARY AND POSITIVE SOLUTIONS OF SOME BOUNDARY VALUE PROBLEMS
Evgeny B. Dynkin *In* Grenoble Univ. Ann. of the Fourier Inst., Vol. XV, No. 1 1965 p 275–282 refs (See N65-33075 21-19) CFSTI: HC $7.00/MF $1.75

All positive harmonic functions satisfying some boundary conditions are investigated. Considered are boundary value problems for the LaPlace equation and Martin boundary, and the Martin boundary associated with the Neumann problem. A probabilistic interpretation and some unsolved problems are included.
G.A.L.

N65-33091 Academia R. P. R., Bucharest (Romania). Institutul de Matematica.
AXIOMATIC THEORY OF HARMONIC FUNCTIONS. NONNEGATIVE SUPERHARMONIC FUNCTIONS
N. Boboc, C. Constantinescu, and A. Cornea *In* Grenoble Univ. Ann. of the Fourier Inst., Vol. XV, No. 1 1965 p 283–312 refs (See N65-33075 21-19) CFSTI: HC $7.00/MF $1.75

Brelot's axiomatic theory of harmonic functions, especially adequate to the theory of linear partial differential equations of elliptic type, is extended to a more general axiomatic theory. The axioms are presented, and a survey is made of some preliminary results. Hyperharmonic functions, nearly-hyperharmonic functions, and the specific order are introduced and studied, in addition to non-negative superharmonic functions. It is shown that a finite non-negative superharmonic function is the specific least upper bound of its specific minorants whose restrictions to their carriers are continuous.
G.A.L.

N65-33157# Purdue Univ., Lafayette, Ind. Dept. of Statistics.
A GENERAL CLASS OF BULK QUEUES WITH POISSON INPUT
Marcel F. Neuts Jun. 1965 25 p refs *Its* Mimeograph Ser. No. 46 (Contract Nonr-1100(26))
(AD-618529)

We assume that customers arrive at a counter according to a homogeneous Poisson process and are served in groups, according to the following policy: If there are less than L customers waiting at the time of a departure, the server must wait until there are L customers present, whereupon he serves them together. If there are L or more, but less than K ($K \geq L$) customers waiting, all are served together. If there are K or more customers waiting, a group of K customers is served and the others must wait. The service times of successive groups are assumed to be conditionally independent given the bulk sizes, but may depend on the group sizes. We obtain (1) a description of the output process, (2) the queue length in discrete time, (3) the distribution of the busy period, (4) the queue length in continuous time and (5) some limit theorems for the number of customers served over a long period of time. The order of service is irrelevant. The method used throughout is that of the imbedded semi-Markov process.
Author

N65-33281*# Maryland Univ., College Park. Computer Science Center.
NON-LINEAR DIFFERENCE EQUATIONS AND GAUSS-SEIDEL TYPE ITERATIVE METHODS
James M. Ortega and Maxine L. Rockoff Aug. 1965 35 p refs (Grant NsG-398)
(NASA-CR-64811; TR-65-20) CFSTI: HC $2.00/MF $0.50 CSCL 12A

An important class of methods for approximating solutions of non-linear systems of equations are the Gauss–Seidel or relaxation processes. The problem of obtaining asymptotic rates of convergence of these methods is treated here by linearization about a solution of the system. This leads to the study of the asymptotic behavior of solutions of perturbed linear difference equations and estimates for the decay rate of such solutions are obtained. These results are then applied to more general difference equations and, in particular, to the difference equations of typical Gauss–Seidel processes. This gives a precise determination of the asymptotic rate of convergence of these processes and is a generalization of known results for linear systems of equations. Application is made to a particular class of non-linear systems arising from mildly non-linear elliptic boundary value problems. In particular, estimates are given for optimum overrelaxation parameters and the results of numerical experiments are presented.
Author

N65-33312# Naval Ordnance Lab., White Oak, Md.
POINTWISE BOUNDS IN THE CAUCHY PROBLEM FOR ELLIPTIC SYSTEMS OF PARTIAL DIFFERENTIAL EQUATIONS
James Conlan and George Trytten Sep. 1965 18 p refs
(NOLTR-65-92; M-59; AD-468848)

This report develops a technique for approximating the solution to a Cauchy problem for a class of second order elliptic partial differential equations in N independent variables. The method is based upon the determination of an a priori bound for an arbitrary u^{α} at a point P in terms of the values of the u^{α} and their gradients on the Cauchy surface, and of a functional of the elliptic operator applied to the u^{α}.
Author

N65-33333# Stanford Research Inst., Menlo Park, Calif.
ON THE USE OF TWO-SAMPLE DECISION PROCEDURE FOR DEPENDENT RANDOM VARIABLES AS A TEST OF "STRICT-SENSE" STATIONARITY
R. C. Mc Carty and G. W. Evans II Jun. 1965 27 p refs
(Contract ARPA SD-103; ARPA Order 281-62)
(TR-28; AD-467488)

This is an expository report of some significant results obtained by K. Matusita in the treatment of the classical "two sample problem" in statistics, when the random variables involved are not necessarily statistically independent. These results should be particularly useful in testing the hypothesis of "strict-sense" stationarity for a sample of radar data obtained from a single sample function over a finite interval in time (O,T). For example, if the interval (O,T) is divided into n equal subintervals, then data samples from pairs of subintervals may be tested to see if they are from the same distribution. The essence of Matusita's results are presented here with some extensions and additional details where required in the interest

of clarity, and they are applied as a distribution-free test of the hypothesis of "strict-sense" stationarity for a generalized random process. Author

N65-33377# Purdue Univ., Bloomington, Ind. Dep. of Statistics.
ON THE BIVARIATE MOMENTS OF ORDER STATISTICS FROM A LOGISTIC DISTRIBUTION AND APPLICATIONS
B. K. Shah Jul. 1965 28 p refs *Its* Mimeograph Ser. No. 48
(Contract AF 33(657)-11737)
(AD-619501)

Let $x_{(1)}, x_{(2)}, \ldots, x_{(n)}$ be an ordered sample of n independent and identically distributed random variables from a logistic distribution whose cumulative distribution function is $[1+\exp(-x)]^{-1}$. In this paper several results are obtained for a simple beta distribution whose density function is $x^{l-1}(1-x)^{m-1}$, $o \leq x \geq 1$. Using these results the exact value of the covariance of the *l*th and mth order statistics is obtained in terms of the diagamma and trigamma functions. Recurrence relations of the covariance of $(l+1)$th, and $(m+1)$th order statistics from a sample of size $(n+1)$ in terms of the lower order covariances and moments are obtained. These relations are useful for the formal solutions of various problems of determination of best linear combinations of order statistics for various estimation problems concerning parameters of a logistic distribution. Table of covariances of all pairs of order statistics for $n \leq 10$ is given. Author

N65-33447# Oregon State Univ., Corvallis.
AN APPLICATION AND GENERATING METHODS FOR MELLIN TRANSFORMS
Bruce Rae Johnson (M.A. Thesis) Jun. 1964 60 p refs
(AD-422999)

Properties of Mellin transforms are applied to the summation of infinite series. A specific example of this application is shown to lead to the establishment of certain properties of a generalization of Lerch's zeta function. Nine methods of generating new tables of Mellin transforms from existing tables of Mellin and other integral transforms are described and illustrated. A table of over 200 examples, which were derived from one of these methods, is included. C.T.C.

N65-33463# Southern Illinois Univ., Carbondale.
ON ALGEBRAIC CURVES WHICH ARE ACTUAL OR APPROXIMATE SOLUTIONS TO AUTONOMOUS AND NON-AUTONOMOUS 2nd ORDER ORDINARY DIFFERENTIAL EQUATIONS Final Technical Report
J. C. Wilson Jul. 1965 44 p refs
(Contract DA-31-124-ARO(D)-238; Grant DA-ARO(D)-31-124-G305)
(AROD-3127-2; AD-619165)

The results compiled in this report are a consequence of the work completed during the last half of the contract and grant period. Results obtained during the first half were incorporated in the paper [1], "Algebraic Periodic Solutions of $x + f(x)\dot{x} + g(x) = 0$", which appeared in Contributions to Differential Equations. In Part I of this report, we cite sufficient conditions in order that the number of periodic solutions of (A) $\ddot{x} + f(x)\dot{x} + g(x) = 0$ be bounded. Examples of such equations are given. Moreover, these examples are shown to furnish instances of structurally stable systems. Part II deals with the non-autonomous equations (B) $\ddot{x} + f(x)\dot{x} + x = h(t)$ and (C) $\ddot{x} + f(x)\dot{x} + x = \mu h(t)$, μ small. We find approximations to equations of type (C), using algebraic curves. Also, we exhibit equations of type (B) which possess algebraic periodic solutions. These are used to approximate periodic solutions of a perturbed equation. Author

N65-33464# Pennsylvania Univ., Philadelphia.
ON INVOLUTIONS OF FIVE SPHERE Interim Technical Report No. 4
Chung-Tao Yang [1965] 6 p refs
(Grant DA-ARO(D)-31-124-G-177)
(AROD-2056-15; AD-619309)

Concepts on the involutions of five sphere were derived from a topological study by Bredon on *Examples of Differentiable Group Actions*. These were shown to be equivalent to certain previously derived concepts by Hirsch–Milnor found in *Some Curious Involutions of Spheres*. M.G.J.

N65-33483# General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility.
RADIATION EFFECTS RELIABILITY AND DATA ANALYSIS Third Quarterly Progress Letter, Oct.–Dec. 1964
[1964] 51 p refs
(Contract AF 29(601)-6308)
(AD-462017)

Presented are data on techniques of graphical analysis, comments on report and planning quality, circuit hardening, test program studies, and circuit test philosophy. Inherent problems associated with the applicability of existing data and test methods in radiation effects and life-testing to a spacecraft mission of 5000 or more hours with nuclear auxiliary power are considered. S.C.W.

N65-33498# Technical Research Group, Inc., Melville, N. Y.
CHORDWISE FORCE ON AN APPENDAGE DUE TO INTERACTION WITH A MOVING PROPELLER BLADE
J. R. Lurye Jan. 1965 61 p refs
(Contract Nonr-3281(00))
(TRG-146-FR; AD-467699)

A method is described for determining the chordwise force on a thin cylindrical appendage of elliptic cross section, due to the motion of a nearby propeller blade. The blade, whose angle of attack can be varied, is likewise a thin cylinder with generator parallel to those of the appendage. Apart from being thin, the blade cross-section can be more or less arbitrary. Interaction between the propeller and the appendage is taken into account. The analysis is divided into two parts. In the first part, an expression for the chordwise force is derived, Equation (2.59) or (2.60), for the case where the appendage is acted upon by an incident flow consisting of a uniform stream plus a small arbitrary time-dependent flow. In the second part, this latter flow is specialized as being due to the propeller blade. Author

N65-33511# Stanford Univ., Calif. Systems Theory Lab.
DISCRIMINANT FUNCTIONS: PROPERTIES, CLASSES, AND COMPUTATIONAL TECHNIQUES
D. W. Peterson Apr. 1965 204 p refs *Its* Tech. Rept.-6761-2
(Contract DA-04-200-AMC-57(Z))
(SEL-65-021; AD-465281)

The research described herein explores and compares properties of discriminant functions that are optimal with respect to one or more diverse criteria. A discriminant function is described as a real-valued function used in the process of deciding which of two or more states of nature is true. The present study is limited to problems involving two states of nature. For purposes of analysis, discriminant functions have been classified, in an original manner, into two types: *optimal form*, and *fixed form*. Seven optimality criteria for discriminant functions are discussed, along with their implications for both fixed-form and optimal-form discriminant functions. A digital-computer method for finding a fixed-form linear discriminant

function which is optimal with respect to some given discriminant function criterion is presented. Some types of discriminant functions more general than the linear are discussed. An application of coding and parameter-selection techniques is made to the problem of finding and simplifying a generalized switching function. Author

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N65-32714# Stanford Univ., Calif.
STANFORD WORLDWIDE ACQUISITION OF METEOROLOGICAL INFORMATION A Student Project in Space System Engineering, Winter and Spring Quarters, 1964
Lee R. Talbert, ed. Jun. 1964 389 p refs
(SUDAER-213)

The use of a satellite system to collect world-wide meteorological data is discussed as the best method in terms of global coverage, speed, reliability, and cost. A fully operational system should consist of the following: (1) three satellites in 1200 nautical miles, circular, polar orbits spaced 120 degrees apart; (2) a micro-electronic, digital computer on board each satellite for interrogation of remote stations, storage of sensor data, and readout to a central ground facility; (3) a network of 3200 free-floating balloons at constant density altitudes of 18000, and 50000 feet, a network of 1200 ocean buoys, and 600 landbased stations; and (4) data transmittal from the satellites with relay to a high-speed digital computer. G.G.

N65-32887# Institut Royal Meteorologique de Belgique, Brussels.
THE WEATHER IN 1964 [LE TEMPS EN 1964]
R. Sneyers 1965 55 p refs In FRENCH *Its* Publ. Ser. B, No. 45 CFSTI: HC $3.00/MF $0.50

Charts, diagrams, tables, and related commentary are presented describing the weather conditions in Belgium during 1964. Wind, atmosphere, temperature, humidity, precipitation, and sun exposure are considered. A detailed, month by month analysis is included. Transl. by G.A.L.

N65-32960*# Meteorology Research, Inc., Altadena, Calif.
MESOSCALE STRUCTURE OF 11–20 KM WINDS
Alan I. Weinstein and Elmar R. Reiter 28 Jun. 1965 52 p refs
(Contract NAS8-5294)
(NASA-CR-61080) CFSTI: HC $3.00/MF $0.50 CSCL 04B

Eleven series of wind speed and direction profiles obtained by tracking spherical superpressure balloons are evaluated. Every profile in each series contains mesoscale perturbations of 5 to 10 m/s and 5 to 10 degrees, over a vertical depth up to 2 km, which persists in recognizable form at approximately the same altitude throughout the series. Several models of mesoscale flow are critically examined, and the model which appears most suitable pictures the wind regime as the result of the relative horizontal motion of stacked layers of large horizontal extent. The concepts of this model are combined with a statistical evaluation of the wind speed profiles series to arrive at a suggested method of forecasting maximum wind shears that might evolve from a given wind speed profile in the altitude range 11 to 20 km. The total wind variation is considered proportional to the thickness of the distinct layer over which it acts. The data show the mean value of the maximum shears to be 0.0088 sec^{-1}, and extreme values about 0.018 sec^{-1}. C.T.C.

N65-33041# Deutscher Wetterdienst, Offenbach am Main (West Germany).
CLIMATIC CHARTS SHOWING THE AVERAGE ANNUAL PRECIPITATION AND PRECIPITATION FREQUENCY FOR THE EUROPEAN COMMUNITY, THE UNITED KINGDOM, DENMARK AND THE ALPS DURING THE PERIOD 1921–1950 (SCALE 1: 5,000,000). PART 1: AVERAGE ANNUAL PRECIPITATION (mm). PART 2: AVERAGE
H. Schirmer and M. Manig Brussels, EURATOM, 1965 16 p
(Contract EURATOM-011-63-12 PSTD)
(EUR-2296.e) CFSTI: HC $1.00/MF $0.50

In the study of problems concerning radioactive contamination of the biosphere, detailed information on the rainfall pattern is indispensable. The Deutscher Wetterdienst at Offenbach/Main prepared two maps on a scale of 1:5,000,000 with an explanatory test, covering the six countries of the European Atomic Energy Community and adjacent territories. These charts show, for the period 1921–1950, the average annual precipitation (in mm) and the average annual number of days with 1.0 mm or more of precipitation. Author

N65-33093 Chicago Univ., Ill. Cloud Physics Lab.
THE AERIAL OBSERVATION OF SNOW AND RAIN CLOUDS
Roscoe R. Braham, Jr. *In its* [Cloud Phys.] 1 Jun. 1965 13 p refs (See N65-33092 21-13)

The role of aerial observations in developing the physics of cloud and weather phenomena is discussed. Emphasis is placed on a model of precipitation process and one of cumulus cloud dynamics developed from airplane observations and measurements. Recent instrumentation developments and instrumentation needs are discussed and include cloud microstructure samplers, precipitation samplers, water content meters, in-cloud electrical sensors, cloud motion measurement, and cloud mixing or entrainment. R.N.A.

N65-33094 Chicago Univ., Ill. Cloud Physics Lab.
AERIAL OBSERVATIONS OF RAIN AND SNOW CLOUDS Selected Bibliography
Roscoe R. Braham, Jr. *In its* [Cloud Phys.] 1 Jun. 1965 28 p refs (See N65-33092 21-13)

A selected bibliography is presented on aerial observations of rain and snow clouds. References are included on cloud microstructure, precipitation particles, liquid water content, air temperature, water vapor content, air motions, electrical parameters, cumulus clouds, layer clouds, clean air, weather systems, cloud climatology, aircraft icing, precipitation, dynamical models, aerosols, and symposia and general texts. R.N.A.

N65-33167# Texas A&M Univ., College Station. Dept. of Oceanography and Meteorology.
RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESO-SCALE SYSTEMS Quarterly Progress Report, 1 Jan.–30 Apr. 1965
John F. Griffiths, Walter K. Henry, and Glenn B. Rumley, Jr. 15 May 1965 100 p refs
(Contract DA-36-039-SC-89202)
(QPR-8; AD-617243)

In order to identify meso-scale changes in the variance of precipitation methods have been devised using relationship

between the means and standard deviations. The preliminary results are very promising. The index of sympathy is used to identify periods of persistant rainfall in geographical areas. The east coast of Costa Rica has a high persistance for some months. The distribution in time and space of rainfall with elevation is investigated for selected stations in Ecuador. Author

N65-33206# Pennsylvania State Univ., University Park. Dept. of Meteorology.
RESPONSE OF SUPERPRESSURE BALLOONS TO VERTICAL AIR MOTIONS
John H. Hirsch and D. Ray Booker 1 May 1965 11 p refs (TN-1D)

A Fortran program was written to simulate a pillow balloon in a given sinusoidal wave, considering the drag and restoring forces which act on the balloon. Over eighty different combinations of wind speed and wave amplitude covering all usual lee wave conditions were used in the equations. Results show that the balloon will underestimate the amplitude and indicate the wave position of maxima and minima too far upstream. The amplitude and measured wave length of the first wave are in serious error. The errors are incorporated into a nomogram to determine the position of an air parcel with respect to the position of a superpressure balloon. The nomogram coupled with the balloon trajectory and known balloon constants yields a means by which the vertical velocities of the air can be found from a radar plot of the balloon's flight. From the balloon trajectory, the time the balloon travels through the wave, its amplutude, and vertical velocities along certain time encrements of its flight can be found. Using known balloon constants, the position of a parcel of air with respect to the balloon's position can be calculated. R.N.A.

N65-33209# Brookhaven National Lab., Upton, N. Y.
CONFERENCE ON AEC METEOROLOGICAL ACTIVITIES MAY 19–22, 1964
Irving A. Singer, Maynard E. Smith, and Eugene W. Bierly, ed. Jun. 1965 191 p refs
(BNL-914(C-42) CFSTI: $5.00

The meteorological programs underway at the various sites in Brookhaven, Argonne, Oak Ridge, Hanford, Cambridge, Nevada, Fort Huachuca, the National Reactor Test Station, and the Dugway Proving Ground were reviewed, and the U. S. Weather Bureau and U. S. Public Health Services programs were discussed at the conference. Major technical problems relating to the meso-scale, air pollution, deposition, dispersion, diffusion, turbulence, micrometeorology, and wind and temperature profiles were also examined. Some 45 reports are included, along with the transcripts of the discussion period following each presentation. M.G.J.

N65-33226# Bollay (E.) Associates, Inc., Goleta, Calif.
OPERATIONAL USE OF WEATHER SATELLITE INFORMATION Final Report
Frederic A. Berry, Paul T. Willis, and John G. Cronin Nov. 1964 212 p refs
(Contracts N62306-1218; N62306-1367; Proj. Famos)
(AD-465092)

Operational use of data obtained with meteorological satellites by the Naval Weather Service is considered. Weather satellite systems, product development and evolution, Navy requirements, communications, and training are discussed. It is concluded that the Navy can utilize data gathered by any type of weather satellite, but that only TV photographs are presently usable on an operational basis. Considered essential to the naval weather program is an operational system with two or more polar orbiting satellites outfitted with Automatic Picture Transmission (APT) or similar systems, which can be interpreted directly by naval units, and a TV or IR system which can deliver the required data. The preparation of operationally useful products from broadscale satellite and APT data is discussed. Satellite characteristics, a guide to cloud photograph interpretation, models of cloud forms based on Tiros photographs, and potential utilization of infrared data are included. M.W.R.

N65-33230# Michigan Univ., Ann Arbor. Dept. of Meteorology and Oceanography.
QUANTITATIVE INTERPRETATION OF LOW-LEVEL CUMULIFORM CLOUD PATTERNS AS SEEN ON METEOROLOGICAL SATELLITE VIDEOGRAPHS
John A. Leese (Ph.D. Thesis) Jul. 1964 222 p refs
(Contract Cwb-10795)
(Rept.-06334-1-T; AD-464606)

Suitable methods were devised for making a conversion based on the relationships found to exist between the parameters used to describe the cloud patterns and other meteorological variables. The cloud patterns in the area were categorized by the amount of coverage, size of the cumuliform cells, and the size of the cloud bands if present. The location and time of the observation with the meteorological data other than the clouds were used to form 23 synoptic parameters. A test was made to determine the capabilities for specifying the value of the meteorological variable, using the values of the cloud parameters and climatology. The cloud variables contributed only a small portion to the total explained variance. An analysis of the useful information contained in the parameters describing the cloud patterns showed that the cloud amount contributed most. The description of the cumulus cell size and banding added very little to the determination of the values for the other meteorological variables. R.W.H.

N65-33276*# Ludwig-Maximilians-Universitat, Munich (West Germany). Meteorologisches Institut.
INVESTIGATION OF ATMOSPHERIC PROPERTIES BASED UPON EVALUATION OF INFRARED RADIATION DATA OBTAINED FROM TIROS SATELLITES Final Report
Erhard Raschke and Irmhild Tannhäuser May 1965 75 p refs
(Grant NsG-305)
(NASA-CR-64805) CFSTI: HC $3.00/MF $0.75 CSCL 04B

The measured values of the TIROS III satellite from the first 6 days after the launch (July. 12.–July. 17. 1961) have been collected in quasiglobal presentations. In the same way are also collected values of the mean relative humidity of the upper troposphere and of the temperature of the emitting surface (cloud or ground), which were derived from the radiation data of the channels 1 (5.8 μ–6.8 μ) and 2 (8 μ–13 μ). Author

N65-33398# Army Electronics Research and Development Acitivity, White Sands Missile Range, N. Mex. Meteorological Support Div.
ATHENA FLIGHT NUMBER 016 (20 JULY 1965) Meteorological Data Report
Harold M. Richart Aug. 1965 61 p
(ERDA-333; AD-468240)

Meteorological data gathered for the launching of Athena Flight Number 016, Vehicle # C-007 are presented for the Air Force Ballistic Missile Re-Entry Systems Office and for ballistic studies. The data are presented in tabular form. Author

N65-33437# Eastern Air Lines, Inc., Miami, Fla. Meteorology Dept.
FLIGHT DATA ANALYSIS OF THE RELATIONSHIP BETWEEN ATMOSPHERIC TEMPERATURE CHANGE AND CLEAR AIR TURBULENCE Final Report
Paul W. Kadlec Jun. 1965 49 p refs
(Contract Cwb-10888)

Certain atmospheric temperature changes have been observed to be a factor in detecting the occurrence of clear air turbulence, especially at jet altitudes above 25,000 feet. Data for this study were collected on 146 flights during the year while riding as an extra crew member in the cockpit of airline and military jet aircraft. An aircraft flight data recorder which was modified to collect static air temperature information, provided another valuable source of research data. The study concentrated on investigating the validity of the theory that temperature gradients may be used to indicate clear air turbulence. A comparison between several rates of temperature change was made in an effort to determine which would indicate actual flight conditions most efficiently. From flight observations using a portable test instrument to detect temperature changes and the flight recorder data, a rate of temperature change of 1.0° C per minute was found to be the most useful criterion for correctly indicating flight conditions in the majority of cases. The aircraft instrumentation in the research program included a portable test instrument as well as the normal components of an air data system and temperature sensors. Author

N65-33438# Stanford Research Inst., Menlo Park, Calif.
THE DISTRIBUTION OF CLEAR AIR TURBULENCE REPORTS AND CLOUD PATTERNS AS SEEN IN SATELLITE PHOTOGRAPHS Final Report
Eldon J. Wiegman Jan. 1965 111 p
(Contract Cwb-10791)

Cloud patterns in satellite photographs taken during four days in April, and two days in May, 1963, were analyzed for areas of clear air turbulence risk. A total of 1,042 reports from aircraft operating between 7,000 and 42,000 feet MSL were evaluated. It was found that turbulence above 30,000 feet MSL of moderate to strong intensity was most commonly associated with jet streams. Cloud patterns offered only limited aid in their location. Turbulence below 20,000 feet was mostly associated with mountainous terrain or frontal clouds. The majority of the latter was located in the warm air above the warm frontal surface. Turbulence existed over cumulonimbus activity within several thousand feet of the cloud top. G.G.

N65-33452# Bollay (E.) Associates, Inc., Goleta, Calif.
AN EVALUATION OF CLOUD DECK AND PRECIPITATION EPISODE FORECASTING ALONG THE WEST COAST Final Report
John G. Cronin 7 Jun. 1965 109 p
(Contract Cwb-10962)

FT and FA messages over one 30 day and one 60 day interval are evaluated in terms of total misses and timing errors in forecasting the occurrence of significant cloud decks and precipitation episodes at four West Coast stations. Precipitation episodes are categorized on a duration basis in an attempt to determine whether relatively long or relatively short duration episodes are more difficult to forecast. The criterion that satellite cloud photographs were available in the pertinent area was applied in the selection of 13 episodes which are illustrated through the use of time sections; cloud photographs are presented as part of the illustration of one episode to show the possible application of this kind of data to the forecasting procedure. Author

N65-33496# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE BWR-X 10 WEATHER RADAR INSTALLATION OF THE VEB DEVELOPMENT PLANT RADIO MECHANICS LEIPZIG
F. Mueller and R. Wagner 13 Jul. 1965 11 p Transl. into ENGLISH from Nachrichtentechnik (E. Berlin), no. 14, 1964 p 235–237
(FTD-TT-65-351/1+2+4; AD-466530)

Described is a ground weather instrument which was designed to eliminate inaccuracies in meteorological determinations induced by echoes from rain, clouds, and other meteorological phenomena. The instrument is equipped with a two-channel receiver, the output of which controls the video amplifier by addition or subtraction circuits. According to the type of operation to which the viewing device is adjusted, the ground weather instrument can show a normal weather radar picture, suppress rain and solid targets, or accent fixed targets. Presented are data on special features which increase the reliability of the instrument, technical specifications for the installation, operating characteristics, and circuitry. S.C.W.

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N65-33021# Federal Aviation Agency, Washington, D. C. Traffic and Economic Analysis Branch.
FORECASTS OF AIR TRAFFIC ACTIVITY 1965–1980 Interim Report
Marjorie B. Halle and Wallace L. Ashby Jul. 1965 24 p
(FAA-RD-65-68)

Projections of active aircraft fleet size during the 1965 to 1980 period have been translated into measures of airspace utilization—flying hours, flights, operations and distances flown. Those measures are categorized by user class, aircraft type, flight rule and type of flight. Author

N65-33175*# Technology Audit Corp., Washington, D. C.
PREDICTED OPERATIONAL REQUIREMENTS FOR A NONMILITARY TRAFFIC COORDINATION AND NAVIGATION SATELLITE SYSTEM Final Report
James W. Campbell [1965] 56p ref
(Contract NASw-809)
(NASA-CR-64804; TAC-107-10) CFSTI: HC $3.00/MF $0.50 CSCL 17G

Existing navigation and communications systems meet the current needs of the nonmilitary navigator for position fixing. Existing or proposed electronic navigation systems could be installed to provide global coverage in the case of the VLF systems or essentially global coverage in the case of Loran C. Under present traffic loads and using existing navigation and radio communications facilities there are peak traffic periods during which trans-Atlantic flights must be diverted either laterally or vertically to avoid conflicts in the use of available airspace. Estimating the future capacity requirements for a global cooperative traffic coordination and navigation system depends on predicting the future composition and distribution of the world and sea fleets. Later estimates of system capacity requirements may be made as additional data become available using present assumptions or other assumptions then deemed more appropriate. R.W.H.

N65-33292# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
THE DESIGN OF COILS FOR THE PRODUCTION OF HIGH HOMOGENEOUS FIELDS [CALCUL DES BOBINAGES POUR LA PRODUCTION DE CHAMPS MAGNETIQUES TRES HOMOGENES]
Henri Desportes Oct. 1964 50 p refs In FRENCH; ENGLISH summary
(CEA-R-2606) CFSTI: HC $2.00/MF $0.50

The discovery of type II superconductors has considerably increased the possibilities of air-core coils, in particular with regard to the production of high homogeneous fields. The design of such magnets calls for elaborate calculations which, in practice, can only be carried out on computers. The present report describes a complete set of programs for the calculation, in the case of cylindrical systems, of the magnetic field components at any point, the lines of flux, the forces, the self and mutual inductances, as well as the design of compensated coils for the production of high homogeneous fields. These programs have been employed for the calculation of two magnets which are described in detail. Author

N65-33417# Honeywell, Inc., St. Petersburg, Fla. Military Products Group.
X-20 A (DYNA-SOAR) PRIMARY GUIDANCE SYSTEM: RELIABILITY PLAN
1 Mar. 1963 41 p Revision C
(Contract AF 33(657)-7133)
(Honeywell-AERO-1179-SR-2B; AD-461048)

A reliability program for the X-20A Dyna Soar inertial guidance subsystem; dependent on individual performance in the design, development, fabrication, test, and field use of system equipment; is outlined. Included are descriptions of the program organization, various design reliability tasks, a data collection system based on an equipment log for success data and a discrepancy report for failure data, various tasks and procedures of a comprehensive failure analysis plan, corrective action for reducing the probability of failure recurrence, the feedback of reliability data, and compliance with reliability requirements using data from development, qualification, and functional tests of the AGE and airborne components of the inertial guidance subsystem. R.N.A.

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N65-32441* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ZERO GRAVITY FEED SYSTEM FOR MERCURY ION ENGINES
T. D. Masek and D. J. Kerrisk *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 150-161 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

The recent concept of the zero-gravity feed system is based on an expanding-diaphragm-type expansion system which forces liquid mercury through a valve to a porous matrix vaporizer, a flowmeter, and a high-voltage isolator. The isolator permits the feed system to operate at spacecraft ground and reduces mounting and high-voltage problems. A schematic diagram of the system is shown and a conceptual design complete thrustor module using this feed system concept is given. The system presently being tested is shown on the vacuum tank header. Initial tests indicate that the system operates as expected. However, sufficient operational time has not been logged to determine quantitative information about the control functions required. From the results to date, the system being studied appears to be worth further investigation. E.E.B.

N65-32548*# Hughes Research Labs., Malibu, Calif. Ion Propulsion Dept.
ION ROCKET ENGINE DEVELOPMENT Summary Report
G. R. Brewer Aug. 1965 287 p refs
(Contract NAS3-4109)
(NASA-CR-54136) CFSTI: HC $6.00/MF $1.50 CSCL 21C

The development of a cesium contact ion rocket engine exhibiting a thrust of 15 mlb at a specific impulse of between 6000 and 9000 sec which can be used as the basis for higher thrust engines by clustering is described. The design and fabrication of the development engines, the development and life tests of the engines, and the supporting research necessary to solve various performance and life limiting problems are presented. R.N.A.

N65-32682# Phillips Petroleum Co., Idaho Falls, Idaho.
FUNDAMENTALS IN THE OPERATION OF NUCLEAR TEST REACTORS. VOLUME 4: ENGINEERING AND DESIGN CONSIDERATIONS FOR IN-PILE TESTS
R. J. Nertney et al Jul. 1965 320 p refs
(Contract AT(10-1)-205)
(IDO-16871-4) CFSTI: $7.00

Various aspects of the experimental programs at the Material Testing Reactor, the Engineering Test Reactor, and the Advanced Test Reactor are discussed and engineering and design fundamentals associated with these programs are reviewed. Discussions are included on various terms and calculations peculiar to the nuclear field, principles of fluid flow and heat transfer; shielding from the experimental viewpoint; the design of in-pile and out-of-pile equipment; sample handling; instrumentation, decontamination; experimental programs dealing with capsules, water loops, and gas loops; the applications of liquid metals and fused salts to the nuclear field; nuclear hazards, and the shipping of radioactive materials. Sample calculations and analyses based on actual experiments are presented in the appendices and also include calculations and information pertinent to the design considerations of out-of-pile equipment. R.N.A.

N65-32764# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
METAL FUEL TUBE MANUFACTURE
Stephen R. Nemeth comp. Jul. 1965 88 p refs
(Contract AT(07-2)-1)
(DP-976) CFSTI: $3.00

Development and fabrication of tubular coextruded Zircaloy-clad uranium metal fuel elements for a heavy water-moderated-and-cooled power reactor is described. Although the majority of tubes had cores of unalloyed uranium, uranium alloys with 2 w/o Zr and with Fe, Si, Al and Mo (approximately 0.2% total) were also included. Some 24 short-length (12-inch) elements were fabricated using brazed end seals rather than the integral end seals used for the long tubes. Fabrication techniques were developed for manufacture of 80 Zircaloy-clad Zr-^{235}U alloy

tubular driver elements, 10 feet long, for the HWCTR. Utilizing the techniques developed for uranium fuel tubes, a number of $Th-^{235}U$ metal fuel tubes were coextruded to pilot the manufacture of $Th-^{233}U$ breeder reactor fuel. Author

N65-32765# Atomics International, Canoga Park, Calif.
DISINTEGRATION AND DISPERSION OF THE SNAP 10A REACTOR UPON RETURN FROM SATELLITE ORBIT
R. D. Elliott 1 Sep. 1965 46 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11103) CFSTI: $2.00

A study of the disintregration and dispersion of the SNAP (Systems for Nuclear Auxiliary Power) 10A reactor upon atmospheric reentry from a satellite orbit is described. The flight configuration is that of the SNAP 10A reactor containing NaK coolant and mated to the forward end of the Agena-D vehicle. It is shown that the SNAP 10A/Agena system will be oscillating in an approximately nose-first attitude at the time of reentry. It is concluded that the reactor components will have disintegrated and dispersed at an altitude of not less than 237,000 ft. Author

N65-32766# Atomics International, Canoga Park, Calif.
THE EFFECTS OF LONG-TERM OPERATION ON SRE SODIUM SYSTEM COMPONENTS
A. I. Hansen 1 May 1965 51 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11396) CFSTI: $3.00

Major components from the main heat transfer system of the Sodium Reactor Experiment were subjected to a performance evaluation after seven years of in-system operation. Selected components were disassembled and/or sectioned for detailed examination and analysis. Retention of fission product in the cold trap and evidence of structural or mechanical weakness in mechanical components as a result of prolonged exposure to sodium were prime areas investigated. A partially saturated cold trap was found to contain fission products and a large number of other impurities in addition to oxides. The main intermediate heat exchanger showed no material defects or weaknesses. Although 24 out of the 316 tubes were found to be blocked by carbonaceous material, no thermal deficiency could be measured. A control rod was examined to determine the effect of prolonged exposure; the poison ring exposed to the highest integrated flux (3.3×10^{20} nvt) revealed a diameter growth of 0.56%. No major defects or weaknesses were discovered in any of the components examined. Author

N65-32781# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
REDUCTION OF PLUTONIUM DIOXIDE TO PLUTONIUM METAL
Major C. Thompson Jul. 1965 12 p refs
(Contract AT(07-2)-1)
(DP-983) CFSTI: $1.00

Attempts were unsuccessful to reduce PuO_2 with calcium or barium to form a coalesced mass of plutonium metal. Molten fluoride fluxes to dissolve CaO or BaO were not effective in promoting the reaction, nor was mechanical agitation. The major difficulty was the rapid separation of the reactant phases. Author

N65-32783# Battelle Memorial Inst., Columbus, Ohio.
PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING JUNE, 1965
Russell W. Dayton and Stan J. Paprocki 1 Jul. 1965 48 p
(Contract W-7405-ENG-92)
(BMI-1733 (Del.)) CFSTI: $1.00

Research relating to civilian applications and having the general objective of providing support to the Atomic Energy Commission's over-all reactor-development program is reported. Data is reported in the following areas: reactor materials and components; fuel studies, radioisotope and radiation applications; coated-particle fuel materials; corrosion studies of the fluidized-bed fluoride-volatility process; and the gas-cooled reactor program. S.C.W.

N65-32784# Battelle Memorial Inst., Columbus, Ohio.
IN-PILE STUDIES OF EXPERIMENTAL PYROLYTIC-CARBON-COATED UC_2 and UO_2 FUEL PARTICLES
Robert L. Ritzman, Robert L. Martin, Neil E. Miller, and Charles W. Townley 28 Jul. 1965 54 p refs
(Contract W-7405-ENG-92)
(BMI-1737) CFSTI: $1.25

The irradiation performance of pyrolytic-carbon-coated UC_2 and UO_2 particles was studied at temperatures ranging from 100 to 1300 C and to fuel burnups of 12 a/o of the U^{235}. It was found that coatings on high-density UC_2 particles must be greater than 110 μ thick in order to survive low-temperature irradiation, and in order to exhibit high integrity at elevated temperatures, the coatings must be multilayered as well. However, by using porous UO_2 fuel particles (~80 percent dense), pyrolytic-carbon coatings as thin as 50 μ performed without failure at low temperature, and a 73 μ columnar coating exhibited only slight failure when irradiated to a U^{235} burnup of 8.4 a/o at 1300 C. Large (460 μ in diameter) porous UO_2 particles with 113-μ laminar pyrolytic-carbon coatings, currently under study, sustained burnups of over 7.5 a/o at 815 C with no indication of coating fracture. Failure at both low and high temperatures is believed to be due primarily to changes induced by fission-fragment recoil in both the fuel-core and coating materials, resulting in stresses in the pyrolytic carbon sufficient to crack the coatings. Author

N65-32788# Atomics International, Canoga Park, Calif.
NONEQUILIBRIUM URANIUM CARBIDE PHASE RELATIONSHIPS
E. E. Ritchie 1 Sep. 1965 30 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-10768) CFSTI: $2.00

Because the solubility of uranium in uranium monocarbide, and the variation of this solubility with temperature, may have an influence on the high-temperature irradiation behavior of hypostoichiometric uranium carbide, a study of the uranium-carbon phase relationships was started. As part of the study, effects of rapid cooling from high temperatures were investigated. Fuel specimens, in the composition range of 4.0 to 4.8 wt % C, were heat treated at 1300, 1600, and 1800° C, followed by rapid (75° C/sec), medium (20° C/sec), and slow (0.4° C/sec) cooling rates. Selected specimens were subsequently vacuum annealed at 650 and 1000° C for periods up to 500 hr. Microstructural observations indicated that the metastable distribution of phases is dependent on heat treatment, and that microstructural changes can occur at expected service temperatures. A two-phase grain boundary structure, observed in both as-cast and heat-treated fuel samples, has been tentatively identified as α uranium containing small grains of $UC_{(1-x)}$. Author

N65-32789# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
COMPUTATIONAL METHODS FOR SPACE RADIATION SHIELDING ANALYSIS

M. P. Billings and R. W. Langley May 1965 43 p refs *Its* Paper No. 3525

Analytical methods and computer programs have been developed for use in establishing the radiation shielding requirements of space vehicle systems. Current techniques for performing space radiation shielding analyses are reviewed in the context of the digital computer programs in which they have been incorporated. Calculations dealing with the transport of primary charged particles and secondary reaction products through matter are performed by the charge program for geometrically simple systems. The calculation of radiation levels in geometrically complex vehicle-shield configurations is accomplished by the Sigma program, using the Quad generalized quadratic surface geometry package. Procedures for ascertaining the optimal distribution of shield mass subject to specific dose design criteria are presently under development. Author

N65-32795# Argonne National Lab., Ill. Reactor Operations Div.
THERMAL NEUTRON FLUXES FOR CP-5 VERTICAL IRRADIATION FACILITIES
D. S. Frazier Mar. 1965 32 p
(Contract W-31-109-ENG-38)
(ANL-7026) CFSTI: $2.00

Thermal neutron fluxes measured in the CP-5 reactor over a two-year period are presented graphically. The method used in measuring the fluxes is described briefly. Author

N65-32801# Sandia Corp., Albuquerque, N. Mex.
MICROWATT RADIOISOTOPE ENERGY CONVERTERS
Warren F. Windle *In* IEEE Trans. on Aerospace, v. 2, no. 2, Apr. 1964 p 646–651
(Contract AT(29-1)-789)
(SC-R-64-1301; CONF-768-1)

After a brief survey of proposed radioisotope conversion systems this paper presents in detail two systems particularly suited for microwatt power sources. First a 10^{-9} ampere Kr^{85} β current cell capable of tens of kilovolts now in limited productions is presented, followed by a discussion of other possible future β current cells. Second, some theoretical considerations of a Pm^{147} silicon electrovoltaic converter with an output in the range of 100 $\mu A/cm^2$ at a few tenths of a volt are discussed. Some applications adapted to each system are also presented. Author

N65-32807# Du Pont de Nemours (E. I.) and Co., Wilmington, Del. Technical Div.
HEAVY WATER MODERATED POWER REACTORS Progress Report, Mar.–Jun. 1965
R. R. Hood comp. Aiken, S. C., Savannah River Lab., Aug. 1965 28 p refs
(Contract AT(07-2)-1)
(DP-975) CFSTI: $2.00

Postirradiation examination was completed on 14 Zircaloy-clad tubes of mechanically compacted UO_2 that operated at maximum thermal ratings of 25 to 40 watts/cm to exposures as high as 17,000 MWD/MTU. The results indicated that the tubes would have been capable of irradiation to even higher exposures. Postirradiation examination of Zircaloy-clad tubes of uranium metal alloyed with small amounts of Fe, Si, and Al revealed that these alloys have excellent promise of operating satisfactorily in a D_2O-moderated power reactor to exposures of about 10,000 MWD/MTU. A multigroup, multiregion code, EPITHET, was developed for calculating neutron flux spectra and neutron absorptions in a cylindrical lattice cell at epithermal energies. Author

N65-32808# Oak Ridge National Lab., Tenn.
SUMMARY OF THE KILOROD PROJECT—A SEMIREMOTE 10-KG/DAY DEMONSTRATION OF $^{233}UO_2$-ThO_2 FUEL-ELEMENT FABRICATION BY THE ORNL SOL-GEL VIBRATORY-COMPACTION METHOD
C. C. Haws, J. L. Matherne, F. W. Miles, and J. E. Van Cleve Aug. 1965 174 p refs
(Contract W-7405-ENG-26)
(ORNL-3681) CFSTI: $5.00

A 10 kg/day demonstration of a sol-gel, vibratory-compaction process for making fuel elements is described. More than 1 metric ton of 3% $^{233}UO_2$-97% ThO_2 solids were prepared, and about 1000 fuel rods were fabricated from the solids. In preparing the feed materials, the ^{232}U daughter products were removed from the ^{233}U by a single-cycle solvent extraction process, and thorium nitrate crystals were converted to a dispersible ThO_2 under a superheated steam atmosphere at 450° to 500° C. In the sol-gel process, $UO_2(NO_3)_2$ and ThO_2 feed stocks are blended at 80° C to form a stable sol. The sol is dried to a gel at 80° C and then calcined and reduced at 1150° C to produce a sintered, fragmented UO_2-ThO_2 product. Fuel rods are then fabricated by crushing the sintered solids through a 6-mesh onto a 16-mesh screen. Photographs of equipment and other process details are also presented. L.S.

N65-32810# Atomics International, Canoga Park, Calif.
THE HIGH-TEMPERATURE IRRADIATION BEHAVIOR OF HYPOSTOICHIOMETRIC URANIUM MONOCARBIDE
R. D. Hahn 31 Aug. 1965 58 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11134) CFSTI: $3.00

A series of three multicompartmented experiments was designed to investigate the irradiation behavior of uranium carbide fuels, as a function of composition, temperature, and burnup; and the mechanical properties of Type 304 stainless steel, as a function of temperature and integrated thermal neutron flux. The capsule was irradiated to a maximum fuel burnup of 19,200 Mwd/MTU at maximum centerline temperatures $\geq$ 3000° F (1300° C). The fuel was swollen and the fuel claddings were failed. In the presence of sodium and a stainless steel carbon sink, hypostoichiometric UC ($<$ 4.8 wt % C) was decarburized. Significant uranium redistribution to the fuel surfaces was observed in all fuel specimens. Fuel-cladding reactions were observed in all the elements. Ring tensile tests from the irradiated Type 304 Stainless Steel fuel cladding, exposed to an integrated thermal neutron flux of 2.1×10^{21} nvt ($\sim 4.2 \times 10^{19}$ nvt $>$ 1 Mev fast flux), showed a decrease in ductility, beginning at 900° F (480° C), which did not recover at 1200° F (650° C). The ductility, compared to that at room temperature, was reduced by a factor of 3 at 1200° F. Author

N65-32822# Argonne National Lab., Ill. Metallurgy Div.
KATHAROMETRIC AND RESISTIVITY STUDIES OF PuO_{2-x} EQUILIBRIA
Leon M. Atlas and Gilbert J. Schlehman Mar. 1963 27 p refs
(Contract W-31-109-ENG-38)
(ANL-6960)

The variation of electrical resistivity (ρ) and x with oxygen pressure has been measured for PuO_{2-x} at 1100 and 1400° C. The procedures, which are described in detail, include (a) equilibrating a ceramic in a once-through stream of H_2-H_2O-He mixture, (b) reoxidizing the specimen to $PuO_{2.00}$ in a fixed volume of helium-oxygen mixture, and (c) analyzing the oxygen content with a thermal-conductivity gas detector. Some data for TiO_{2-x} at 1200 and 1300° C have also been obtained to check the gas-analysis method. Experimental results for PuO_{2-x}

are presented as plots of log x vs log $p(O_2)$, log ρ vs log $p(O_2)$ and ΔG_O° (the relative partial molar free energy of oxygen in the solid) vs log x. A mass-action analysis is presented that relates the slope difference to a variation of the activity coefficient of Pu^{+3} ions with the concentration of defects. At 1100° C, these defects are thought to be primarily quadruply dissociated interstitial plutonium atoms. Author

N65-32830# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
FLUIDIZED BED CALCINATION OF SIMULATED ZIRCONIUM FLUORIDE WASTE IN EXPLORATORY PILOT PLANT TESTS
J. C. Petrie, E. J. Bailey, D. W. Rhodes, and B. M. Legler Jul. 1965 39 p refs
(Contract AT(10-1)-205)
(IDO-14653)

An exploratory pilot plant study of the fluidized bed calcination of zirconium fluoride waste with added calcium nitrate has shown that greater than 99 percent of the fluorides in the waste are retained in the calcined solids. Laboratory studies have indicated that mole ratios of calcium to fluoride considerably below the stoichiometric ratio were effective in suppressing fluoride volatilization. Corrosion tests conducted during the pilot plant study demonstrated that the austenitic stainless steels of which the Waste Calcining Facility is constructed will not be excessively corroded during calcination of zirconium fluoride waste in that facility. Author

N65-32835# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucléaires.
CONTINUOUS MEASUREMENT OF NEUTRON FLUX WITH THE AID OF A CONVERTER DEVICE [MESURE CONTINUE DES FLUX DE NEUTRONS A L'AIDE D'UN DISPOSITIF CONVERTISSEUR]
Pierre Mas and Paul Sciers 1964 15 p refs In FRENCH
(CEA-R-2560)

A converter device based on the capture of β particles for the continuous measurement of thermal and epithermal neutron flux is described. The device consists of an emitter which produces positive or negative β particles; a dielectric of aluminum or magnesium; and a condenser of any conducting material which will sufficiently stop β particles. Experimental flux measurements are taken of rhodium 104, and are presented in tabular form. Transl. by G.A.L.

N65-32844# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
SIMPLE MODELS FOR COMMON THERMALIZERS [MODELES SIMPLES POUR LES THERMALISEURS USUELS]
Jean-Louis Soule Aug. 1964 20 p refs In FRENCH
(Contract EURATOM-037-60-12 RDF)
(CEA-R-2473)

A secondary model is proposed for simplified calculation of thermal and epithermal spectra, and is illustrated in application to physical models currently in use for certain common nuclear reactor moderators. Transl. by M.M.D.

N65-32846# Argonne National Lab., Ill. Reactor Physics Div.
TABLES OF RESONANCE INTEGRAL FUNCTIONS, $L'(Z',\xi)$
Edwin M. Pennington Mar. 1965 21 p refs
(Contract W-31-109-ENG-38)
(ANL-7024) CFSTI: $1.00

Tables of the function $L'(Z', \xi)$, which occurs in the calculation of resonance integrals for absorbers without admixed moderator in the NRIA approximation, have been computed by use of the CDC-3600. The values are calculated in slab, cylindrical, and spherical geometry for $\xi = 0.02, (0.01), 0.05, (0.05), 0.50$, and ∞, and for $j = -2, (0.5), 14$ where $Z' = 2^{-j} + 10^{4}$. Author

N65-32864*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DESIGN STUDY OF A FISSION-ELECTRIC CELL REACTOR
Jerome L. Shapiro 1 Aug. 1965 25 p refs
(Contract NAS7-100)
(NASA-CR-64633; JPL-TR-32-741) CFSTI: HC $1.00/MF $0.50 CSCL 18L

A design approach is developed for the application of a fission-electric cell reactor to the generation of power in space. For a graphite moderated reactor, the total size, temperature, and total thermal power are fixed. The remaining parameters, including cell dimensions and voltage, are then selected to optimize the overall efficiency. To simply the calculations, two group reactor theory is used, investigating both the single region and two region core concepts. From the standpoint of overall efficiency, it is shown that the two region core is advantageous only for low efficiency systems and hence offers little promise. Another important result of these calculations is that the optimum operating voltage is shifted downward from the optimum as calculated without considering criticality limitations. This means that the maximum efficiency requirement is reduced considerably and indicates that the criticality requirement may be a more severe limitation than the effect of voltage breakdown within the cell. Author

N65-32905# Atomics International, Canoga Park, Calif.
PYROCHEMICAL REPROCESSING OF URANIUM CARBIDE Summary Report
E. W. Murbach and G. E. Brand 31 Aug. 1965 40 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11340) CFSTI: $2.00

A program has been carried out to investigate low decontamination reprocessing of uranium carbide reactor fuel. Three processes were investigated: (1) The CARBOX process which is based on oxidation-carbothermic reduction; (2) A nitride-carbide cycle in which UC is converted to a nitride and then reconverted to the carbide; and (3) A fused-salt electrolysis process in which UC is anodized in a KCl-LiCl salt bath and the uranium cathode deposit converted to UC by reaction with propane in mercury at 350 to 600° C. Decontamination by all three processes was studied with lightly irradiated UC ($nvt \sim 10^{17}$). The CARBOX and nitride processes remove about 75% of the fission products, but plutonium losses are high. The electrolysis process removes most fission products except zirconium. Reaction kinetics were studied for a number of the processes. Author

N65-32913# Atomics International, Canoga Park, Calif.
COMPATIBILITY OF URANIUM CARBIDE FUELS WITH CLADDING MATERIALS
P. E. Elkins 1 Aug. 1964 35 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-7502)

Compatibility experiments were conducted to determine the compatibility limitations of UC fuels with several cladding materials, both in a sodium environment and in direct contact. Hypostoichiometric UC was compatible with stainless steel type 304 under conditions of loosely fitted fuel specimens in capsules of the cladding materials in the presence or absence of a sodium bonding medium. At temperatures below 1800° F, neither uranium nor carbon was transferred by the sodium to these

cladding materials. Hyperstoichiometric UC without a liquid metal bonding medium is compatible, up to 1600° F, with the three cladding materials to the extent that the observed reactions, even at 1600° F, were localized and limited in depth. In a sodium environment, this fuel is incompatible with type 304 stainless steel by reason of the high carbon activity of hyperstoichiometric UC, the effective carbon transfer path offered by the sodium, and the carburizing potential of stainless steel. Below 1600° F, Nb-1% Zr and 3Z1 capsules containing carbon saturated sodium exhibited satisfactory compatibility. At higher temperatures, carburization rates were excessive. R.N.A.

N65-32975# Commissariat a l'Engergie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
PROTECTIVE SHEETING FOR IRRADIATED FUEL ELEMENTS—A RAPID EVALUATION [BLINDAGES DE PROTECTION POUR LES ELEMENTS COMBUSTIBLES IRRADIES EVALUATION RAPIDE]
J. Guirlet, C. Jain, J. M. Lavie, and G. Lucas 1963 98 p refs In FRENCH; ENGLISH summary
(CEA-2288) CFSTI: HC $3.00/MF $0.75

The calculation of the protection required for the handling of irradiated fuels necessitates a knowledge of the γ spectrum as a function of the burn-up, of the activation time, and of the "cooling" time, all of which involves lengthy and difficult calculations. With a view to simplifying them we have established diagrams, using literature data, which make it possible to find rapid solutions to the various problems which can arise. The γ activity of the various fission products has been classified into seven groups corresponding to the intervals in which their γ energy falls. Curves have been drawn up in function of the time of irradiation and of the "cooling" time. They give, for each of the seven groups the γ activity in MeV/s for a power of 1 W. From these curves, diagrams have been built up making it possible to solve protection problems for lead, iron, ordinary concrete, barium oxide concrete, and heavy concrete. Author

N65-33016# Douglas Aircraft Co., Inc., Santa Monica, Calif.
NEUTRONIC COUPLING OF CLUSTERED NUCLEAR ENGINES
J. S. Woyski and R. W. Langley [1964] 26 p refs Presented at the Winter Meeting of the Am. Nucl. Soc., San Francisco, 1 Dec. 1964 *Its* Paper No. 3109

Nuclear propulsion engines operating in a cluster arrangement are subject to an exchange of neutron radiation. This paper presents a method of analysis suitable for parametric studies to determine the degree of neutronic coupling and how it affects engine performance and control stability. Results are presented for several representative nuclear engine designs in various cluster arrangements. The calculated reactivity coupling, using the albedo concept to represent the interchange of neutrons, is compared to experimental data for two KIWI B reactors. Author

N65-33018# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
NUCLEAR TECHNOLOGY BRANCHES QUARTERLY REPORT, OCTOBER 1–DECEMBER 31, 1964
D. R. de Boisblanc, W. C. Francis, M. E. Thomas, R. G. Fluharty, and L. A. Schmittroth Jul. 1965 151 p refs
(Contract AT(10-1)-205)
(IDO-17081) CFSTI: $4.00

Research is reported under the following subject headings: *REACTOR ENGINEERING; NUCLEAR TECHNOLOGY; INSTUMENT DEVELOPMENT;* and *MATHEMATICAL ANALYSIS AND MACHINE COMPUTATIONS.* Progress is reported in the following areas: materials research, metallurgical development, nuclear chemistry, theoretical physics, reactor experiments instrumentation analysis, instrument component and systems development, and further Monte Carlo studies. S.C.W.

N65-33024# Argonne National Lab., Ill.
REACTOR DEVELOPMENT PROGRAM Progress Report Jul. 1965
R. M. Adams and A. Glassner 24 Aug. 1965 84 p refs
(Contract W-31-109-ENG-38)
(ANL-7082) CFSTI: $3.00

Technical progress is reported on liquid-metal-cooled reactors, general reactor technology, advanced systems research and development, and nuclear safety. Preliminary results and data are also presented. R.W.H.

N65-33029# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
USE OF CADMIUM IN SOLUTION IN THE EL 4 REACTOR MODERATOR, IRREVERSIBLE FIXING OF CADMIUM ON THE METALLIC SURFACES [UTILISATION DU CADMIUM EN SOLUTION DANS LE MODERATEUR DU REACTEUR EL 4—FIXATION IRREVERSIBLE DU CADMIUM SUR LES SURFACES METALLIQUES]
Odette Croix, Odette Paoli, Jean Lecomte, Lucien Dolle, and Y. Legallic (Lab. de Mésure Radioéléments) Aug. 1964 44 p refs In FRENCH; ENGLISH summary
(CEA-R-2504) CFSTI: HC $2.00/MF $0.50

In the framework of research into the poisoning of the EL 4 reactor by cadmium sulphate, measurements have been made by two different methods of the residual amounts of cadmium liable to be fixed irreversibly on the surfaces in contact with the heavy water. A marked influence of the pH has been noticed. The mechanism of the irreversible fixing is compatible with the hypothesis of an ion-exchange in the surface oxide layer. In a sufficiently wide range of pH the cadmium thus fixed causes very little residual poisoning. The stability of the cadmium sulphate solutions is however rather low in the conditions of poisoning. Author

N65-33034# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
NON-DESTRUCTIVE DETERMINATION OF THE BURN-UP OF A NUCLEAR FUEL USING γ SPECTROMETRY [DETERMINATION NON DESTRUCTIVE DU TAUX DE COMBUSTION D'UN COMBUSTIBLE NUCLEAIRE PAR SPECTROMETRIE γ]
Charles Englemann and Jean-Francois Petit Aug. 1964 35 p refs In FRENCH; ENGLISH summary
(CEA-R-2542) CFSTI: HC $2.00/MF $0.50

A non-destructive method has been developed for measuring the burn-up of a nuclear fuel. The principle of the method is based on the quantitative determination of a fission product using γ spectrometry. For fuel elements containing uranium 235, the measurements concern the photo-electric peak at 2.18 MeV of ^{144}Ce which has a half-life of 290 days. The same method could be applied under certain conditions: (a) to the measurement of the number of fissions due to ^{239}Pu, by dosing the ^{106}Rh deriving from the ^{106}Ru and having a half-life of 370 days. (b) and therefore possibly to the non-destructive determination of the quantity of ^{239}Pu present in a fuel element. If the operational programme of the reactor is known as a function of time, the possible field of application of the method is extended to times of irradiation of from two to three years. Author

N65-33037# Commissiat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
RECENT DEVELOPMENTS IN THE FIELD OF REFRACTORY FUELS [DEVELOPPEMENTS RECENTS DANS LE DOMAINE DES COMBUSTIBLES REFRACTOIRES]
André Accary and Roger Delmas 1964 17 p refs In FRENCH; ENGLISH summary
(CEA-R-2674) CFSTI: HC $1.00/MF $0.50

Progress is reported in the field of ceramic fuels. Effort was concentrated on developing a process for preparing UO_2 powder suitable for sintering. Microstructural aspects and pore distribution; mechanical and thermal behavior in cylindrical form; control of excess oxygen; and behavior of the gaseous fission products at high temperature after or during irradiation are discussed. Also, the determination of conditions of industrial manufacturing of a suitable reactor fuel with a composition close to UC led to investigations of the following: (1) nonstoichiometric UC; (2) influence of oxygen and nitrogen on the properties of UC; (3) compatibility of UC alloys with different metallic and ceramic materials; (4) corrosion of UC by water and CO_2; (5) method of preparation of high purity samples; and (6) in-pile irradiation devices for the investigation of these materials at high temperatures. Methods of fabrication of UC alloys were also investigated. E.E.B.

N65-33039# Commissariat a l'Energie Atomique, Chusclan (France). Centre de Production de Plutonium de Marcoule.
SIX YEARS' WORKING EXPERIENCE OF THE MARCOULE PLANT FOR TREATMENT OF IRRADIATED FUEL [EXPERIENCE DE 6 ANNEES DE FUNCTIONNEMENT DE L'USINE DE RETRAITEMENT DE MARCOULE]
Claude Jouannaud, Marcel Chambon, Rene Riolfo, and Andre Fontaine 1964 19 p refs In FRENCH; ENGLISH summary
(CEA-R-2698) CFSTI: HC $1.00/MF $0.50

The irradiated fuel treatment plant at Marcoule began treating rods from the pile G 1 in July 1958. These six years' experience of the plant in operation have led to the confirmation or revision of the original ideas concerning the process as well as the technology or methods of exploitation. The process as a whole has suffered little modification, the performances having proved better than originally foreseen; the only alterations made were justified by greater simplicity of operation, better nuclear security (criticality) or for technological reasons. The processes of plutonium reduction from valency IV to valency III by uranium IV, and of concentration of fission product solutions in the presence of formaldehyde, have always given complete satisfaction. Author

N65-33104# Southwest Research Inst., San Antonio, Tex. Dept. of Electronics and Electrical Engineering.
NONDESTRUCTIVE ASSAY OF NUCLEAR FUELS Final Report
Warren J. Mc Gonnagle, Raymond R. Nydegger, and Demetrios L. Basdekas Washington, AEC, 26 May 1964 80 p refs
(Contract AT(11-1)-1321)
(TID-21475) CFSTI: $3.00

A feasibility study is presented to determine how the fissionable material content of both irradiated and unirradiated nuclear fuels can be measured nondestructively. Various testing techniques were evaluated, and calculations were made to determine the accuracy of these techniques. The Compton magnetic spectrometer and electrostatic spectrometer were evaluated and a discussion of the threee major designs is included. The use of solid state detectors in gamma spectrometry is discussed and some of the advantages and disadvantages are cited. An evaluation is also included for X-ray transmission, neutron transmission, induced fission, and activation analysis for measuring fissionable material. C.T.C.

N65-33124# Argonne National Lab., Ill. Reactor Physics Div.
METHOD FOR NEUTRON-FLUX STUDIES IN AN OPERATING POWER REACTOR USING BARE AND CADMIUM-COVERED RADIOACTIVANTS
W. G. Knapp Mar. 1965 27 p refs
(Contract W-31-109-ENG-38)
(ANL-7011) CFSTI: $2.00

A method of study of neutron-flux distributions and energy spectra in the core of an operating nuclear power reactor has been developed. The foil-activation technique, including the use of cadmium absorber covers, has been adapted in a way that overcomes the access limitations of most power reactors. Small spherical foils are inserted through the tube irradiation facilities having a 3/16-in. OD into selected locations in the core without affecting the reactor operation. Both insertion and removal are performed with pneumatic transfer methods. The small (1/16-in.-diameter) spherical foils can be fabricated from a variety of detector materials and are particularly adapted to automatic analysis techniques. An automatic sample changer is described that was used extensively during the initial demonstration of the method in the Experimental Boiling Water Reactor (EBWR). Modifications and recommendations based on actual experience with the method in the EBWR are given. Author

N65-33249# Sandia Corp., Albuquerque, N. Mex.
SHORT CUT METHOD FOR DIMENSIONAL ANALYSIS
A. V. Houghton, III (New Mexico Univ.) and David G. Kitzinger Sep. 1965 12 p
(SC-RR-65-306) CFSTI: $1.00

Generalized matrix methods for the solution of dimensional analysis problems are described. A simplified method for producing dimensionless products is illustrated by a sample problem. By the simplification method, complete sets of dimensionless products are obtained almost by inspection. Author

N65-33271# United Kingdom Atomic Energy Authority, Risley (England). Reactor Group.
REACTIVITY FEEDBACK IN THE DOUNREAY FAST REACTOR, AUGUST 1962–DECEMBER 1963
R. C. Wheeler and D. Tait 1965 75 p refs
(TRG-864(D)) CFSTI: HC $3.00/ME $0.75

The measurements of reactivity feedback during three charges are described. These include the isothermal temperature coefficients, the steady-state power coefficients (as functions of power and flow), the responses to oscillating reactivity input, and some responses to negative ramp reactivity changes. A significant decrease in the negative core feedback for small changes was observed between the first measurements at low burn-up and the later measurements, when the reactor was first run at full power. This decrease is attributed partly to the change to non-interlocked fuel and partly to the cracking of fuel on burn-up. The overall fast-acting feedback was found to be positive (although small) during part of the period considered. The reasons why the negative feedback for small changes is different from the feedback calculated for large changes are discussed. The calculations of the feedback are outlined, and the main uncertainties which remain are concerned with the blanket flow rates (and thus blanket temperatures), the bowing of control rod elements, and the axial expansion of the fuel. Author

N65-33394# Pennsylvania State Univ., University Park. Dept. of Enginering Mechanics.
CASCADE ARRANGEMENT IN SPERCAL VESSEL DESIGN FOR NUCLEAR POWER REACTORS

L. W. Hu and J. Schutzler Jan. 1965 29 p refs
(Grant AF-AFOSR-127-64)
(AFOSR-65-0315; AD-614591)

Pressure vessels in cascade arrangement is suggested for nuclear power reactor design. The stress analysis and a procedure for the minimum weight design of cascade spherical shells are presented. A numerical example of two stage spherical shells is given to demonstrate the procedures developed as well as the need of such type of pressure vessels in nuclear power reactor design. Author

N65-33454# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
EXPERIMENTAL AND ANALYTICAL PROGRAM RECOMMENDATIONS. REACTOR PIPE RUPTURE STUDY
H. H. Klepfer, comp. Jan. 1965 84 p refs
(Contract AT(04-3)-189)
(GEAP-4474) CFSTI: $3.00

Preliminary studies indicate a high degree of piping reliability, but the likelihood of reactor pipe ruptures has suggested a variety of experimental and analytical research and development tasks. The ten general areas for future studies are reliability and engineering, stress analysis, fracture mechanics, fatigue, localized corrosion cracking, impact erosion by wet steam, quality assurance procedures, operational surveillance development, creep fatigue, as well as large-scale testing to validate laboratory results. Program requirements, recommended programs, and relevance of these to overall objectives are delineated. M.W.R.

N65-33534# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucléaires.
PREPARATION AND PROPERTIES OF CARBONACEOUS PRODUCTS PREPARED BY THE CRACKING OF NATURAL GAS [FABRICATION ET PROPRIETES DE CORPS CARBONES PREPARES PAR CRAQUAGE DE GAZ NATUREL]
Pierre-Lazare Blum, Louis Bochirol, Jean Rappeneau, Pierre Cornuault, Claude Moreau et al 1964 43 p refs In FRENCH; ENGLISH summary
(CEA-R-2535) CFSTI: HC $2.00/MF $0.50

Complete results are presented of tests conducted to transform natural gas, used as a source of pyrolytic carbon, into carbonaceous products with improved properties. Several methods were studied: (1) By using grade industrial graphite as support (density of about 1.50) products having densities of about 1.80 are obtained. Their open porosity (6 to 7 percent) is lower than conventional graphites, and several characteristics are equal to, or better than those obtained from a double impregnation with pitch. (2) The use as supporting material of the semi-products ("cooked") does not lead to satisfactory results. The main reasons for this are given. (3) A new process was developed with powdered products (petrol coke or graphite), used as starting materials. These are put into shape with the use of a binder which can be dispersed in water. These supports make it possible, because of their porous structure, to utilize the densification produced by cracking natural gas below 1000° C. The products obtained, consisting of equal amounts approximately of the supporting material and of pyrocarbon, can attain densities of over 1.90. Their very low open porosity can be reduced almost to zero, and their impermeability is then excellent ($k = 10^{-8} cm^2 sec^{-1}$). They also have a high resistance to compression with values of 15 to 20 kg/mm^2 obtained for carbons which have not undergone a final graphitization treatment. Author

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N65-32415* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SYMMETRIZATION OF THE TWO-BODY PROBLEM
R. Broucke *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 23-28 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

A change of variables for the perturbed two-dimensional two-body problem that transforms the equations of motion to a new form which presents greater simplicity than the usual equations is described. The change of variables used consists of a transformation of the spatial variables x, y, together with a change of the independent variable t. The coordinate transformation is the ordinary transformation to parabolic coordinates, and the independent variable (time) is replaced by another variable which is essentially equivalent to the eccentric anomaly. The main effect of this change of variables is to transform the two-body problem into the two-dimensional harmonic oscillator. Thus a problem which has a very simple solution in sine and cosine terms is achieved for the condition when no perturbations are present. In the perturbed two-body problem, this symmetrization also simplifies many of the equations. The formulation presented is completely general. E.E.B.

N65-32416* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
QUANTUM MECHANICS AND STOCHASTIC PROCESSES
R. W. Davies and H. Lass *In its* Space Programs Sum. No. 37-33, vol. IV 30 Jun. 1965 p 28-32 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

A stochastic differential equation is derived and it is shown that the time-varying one-dimensional Schroedinger wave equation can be put into the identical form. Also, it is shown that the formulation is consistent with the Heisenberg uncertainty principle. E.E.B.

N65-32459* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A COMBINED FOCUSING X-RAY DIFFRACTOMETER AND NONDISPERSIVE X-RAY SPECTROMETER FOR REMOTE ANALYSIS: A PRELIMINARY REPORT
H. W. Schnopper (Cornell Univ.), A. E. Metzger, R. A. Shields, and K. Das Gupta *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 235-244 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

An instrument is described for the performance of a dual-purpose analysis consistent with the following: reasonably high sensitivity, atomic number resolution, lattice spacing resolution, low power requirements, rapid data accumulation, and simplicity of mechanical construction and operation. The primary objective is the remote analysis of lunar material; however, the instrument also may have application in the laboratory. A breakboard model of the combined diffractometer-spectrometer is shown. Results have confirmed the design expectations. E.E.B.

N65-32633 College of Advanced Technology, Salford (England). Dept. of Mathematics.
GENERALIZATION OF LAPLACE'S EXPANSION TO ARBITRARY POWERS AND FUNCTIONS OF THE DISTANCE BETWEEN TWO POINTS
In Chicago Univ. [Studies in Mol. Struct. and Wavefunctions] [1964] p 282–288 refs Repr. from J. Math. Phys., v. 5, no. 2, Feb. 1964 Work Performed in Part at Chicago Univ. and Wisconsin Univ. (See N65-32626 21-24)
(Grant NsG-275-62(4180))

In analogy to Laplace's expansion, an arbitrary power r^n of the distance r between two points $(r_1, \vartheta_1, \phi_1)$ and $(r_2, \vartheta_2, \phi_2)$ is expanded in terms of Legendre polynomials of cos ϑ_{12}. The coefficients are homogeneous functions of r_1 and r_2 of degree n satisfying simple differential equations; they are solved in terms of Gauss' hypergeometric functions of the variable $(r_</r_>)^2$. The transformation theory of hypergeometric functions is applied to describe the nature of the singularities as r_1 tends to r_2 and of the analytic continuation of the functions past these singularities. Expressions symmetric in r_1 and r_2 are obtained by quadratic transformations; for $n = -1$ and $n = -3$; one of these has previously been given by Fontana. Some three-term recurrence relations between the radial functions are established, and the expressions for the logarithm and the inverse square of the distance are discussed in detail. For arbitrary analytic functions f(r), three analogous expansions are derived; the radial dependence involves spherical Bessel functions of $(r_<\delta/\delta r_>)$ of related operators acting on $f(r_>)$, $f(r_1 + r_2)$ or $f[(r_1^2 + r_2^2)^{1/2}]$.
Author

N65-32634 College of Advanced Technology, Salford (England). Dept. of Mathematics.
THREE-DIMENSIONAL ADDITION THEOREM FOR ARBITRARY FUNCTIONS INVOLVING EXPANSIONS IN SPHERICAL HARMONICS
R. A. Sack *In* Chicago Univ. [Studies in Mol. Struct. and Wavefunctions] [1964] p 289–296 refs Repr. from J. Math. Phys., v. 5, no. 2, Feb. 1964 Work Performed in Part at Chicago Univ. and Wisconsin Univ. (See N65-32626 21-24)
(Grant NsG-275-62(4180))

For any vector $r = r_1 + r_2$ an expansion is derived for the product of a power r^N of its magnitude and a surface spherical harmonic $Y_L^M(\vartheta, \phi)$ of its polar angles in terms of spherical harmonics of the angles (ϑ_1, ϕ_1) and (ϑ_2, ϕ_2). The radial factors satisfy simple differential equations, their solutions can be expressed in terms of hypergeometric functions of the variable $(r_</r_>)^2$, and the leading coefficients by means of Gaunt's coefficients or 3j symbols. A number of linear transformations and three-term recurrence relations between the radial function are derived; but in contrast to the case L = 0, no generally valid expressions symmetric in r_1 and r_2 could be found. By interpreting the terms operationally, an expansion is derived for the product of $Y_L^M(\vartheta,\phi)$ and an arbitrary function f(r). The radial factors are expansions in derivatives of $f(r_>)$; for spherical waves, they factorize into Bessel functions of r_1 and r_2 in agreement with the expansion by Friedman and Russek. The 3j symbols are briefly discussed in an unnormalized form; the new coefficients are integers, satisfying a simple recurrence relation through which they can be arranged on a five-dimensional generalization of Pascal's triangle.
Author

N65-32635 College of Advanced Technology, Salford, England. Dept. of Mathematics.
TWO-CENTER EXPANSION FOR THE POWERS OF THE DISTANCE BETWEEN TWO POINTS
R. A. Sack *In* Chicago Univ. [Studies in Mol. Struct. and Wavefunctions] [1964] p 297–305 refs Repr. from J. Math. Phys., v. 5, no. 2, Feb. 1964 Work performed in part at Wisconsin Univ. and Chicago Univ. (See N65-32626 21-24)
(Grant NsG-275-62(4180))

The power r^n of the distance between two points specified by spherical polar coordinates relating to two different origins, or of the modulus of the sum of three vectors, are expanded in spherical harmonics of the angles. The radial factors satisfy simple partial differential equations,and can be expressed in terms of Appell functions F_4 and Wigner or Gaunt's coefficients. In the overlap region, first discussed by Buehler and Hirschfelder, the expressions are valid for integer values of $n \geq -1$, but in the other regions, for arbitrary n. For high orders of the harmonics, individually large terms in the overlap region may have small resulting sums; as a consequence the two-center expansion is of limited usefulness for the evaluation of molecular integrals. Expansions are also derived for the three-dimensional delta function within the overlap region, and for arbitrary functions $f(r)$, valid outside that region.
Author

N65-32883*# Texas Univ., Austin. Dept. of Civil Engineering.
A LATTICE ANALOGY FOR THE SOLUTION OF SOME NONLINEAR STRESS PROBLEMS
Robert E. Smith and Lymon C. Reese May 1965 155 p refs
(Grant NsG-604)
(NASA-CR-64453) CFSTI: HC $5.00/MF $1.00 CSCL 20K

The lattice analogy technique for solving plane stress problems is extended to solve plane strain problems. Solutions to two-dimensional stress problems in linear homogeneous mediums are made feasible by using matrix algebra and an electronic digital computer. Solutions of a plane stress problem are presented. The method of solution is extended to nonhomogeneous linear mediums for the two-dimensional stress case. Extension of the method of solution to the general three-dimensional stress case is discussed. Required developments for this extension are enumerated and recommendations made. A method for solving two-dimensional stress problems in nonlinear mediums using the lattice analogy technique is presented. Solutions to two nonlinear stress problems are also presented.
R.N.A.

N65-32885*# Case Inst. of Tech., Cleveland, Ohio.
SIMPLE SHOCK ISOLATOR SYNTHESIS WITH BILINEAR STIFFNESS AND VARIABLE DAMPING
Lucien A. Schmit, Jr. and Edmund F. Rybicki Jun. 1965 115 p refs
(Grant NsG-110-61)
(NASA-CR-64710; EDC-2-65-9) CFSTI: HC $4.00/MF $1.00 CSCL 20K

An extension of the previously reported synthesis capability for a simple shock isolator is presented. Advances in the engineering scope and the algorithmic efficiency of the previous work are offered. A one degree of freedom system with a single package of mass M is to be protected from a multiplicity of shock pulses. Two common situations are considered. In the first type of problem a design is sought which minimizes the absolute acceleration felt by the package subject to relative displacement limitations. In the second type of problem a design is sought which minimizes the relative displacement subject to limitation on the absolute acceleration felt by the package. Three design variables are employed to characterize the bilinear spring and six additional design variables are used to represent a piecewise-linear variable damping coefficient. The synthesis technique employed is based on an implementation of the gradient projection method with certain special additional features. Results for several numerical examples are presented.
Author

N65-32908# Sandia Corp., Albuquerque, N. Mex.
BRAGG SCATTERING FROM A CRYSTALLINE POWDER OF BERYLLUIM IRRADIATED BY A CONTINUOUS X-RAY SPECTRUM
Frank Biggs Aug. 1964 12 p refs
(Contract AT(29-1)-789)
(SC-RR-64-1207)

Where it is assumed that a continuous spectrum of x rays is incident on the sample, the x-ray spectrum scattered from a sample of crystalline powder beryllium by Bragg reflections is calculated. This calculation is made for the important crystal planes and for the first three orders. Author

N65-32922# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics.
FIFTH STUDENT SYMPOSIUM ON ENGINEERING MECHANICS
T. R. Branca, M. L. Roller, T. A. Zajicek, and R. W. Harney Jun. 1965 40 p refs
(T&AM-280)

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1. THE TURBULENT WAKE OF SYMMETRICAL BODIES T. R. Branca 16 p refs
2. METHODS OF ALTERING IMPEDNACE IN A FLEXIBLE CLOSED WALL FLUID SYSTEM M. L. Roller 19 p refs
3. PHOTOELASTIC ANALYSIS OF AN OBLIQUE SLICE FROM A REINFORCED CYLINDRICAL VESSEL T. A. Zajicek 9 p refs
4. ROTATIONALLY SYMMETRIC PLANE STRESS DISTRIBUTION FOR BODIES OF VARYING THICKNESS 7 p refs

N65-32971*# National Aeronautics and Space Administration, Washington, D. C.
MAGNETIC FIELD OF SUNSPOTS, PART II [MAGNITNOYE POLE SOLNECHNYKH PYATEN. II]
L. E. Gurevich and A. I. Lebedinskiy Sep. 1965 14 p refs Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow), v. 16, no. 9, 1946 p 840–848
(NASA-TT-F-257) CFSTI: HC $1.00/MF $0.50 CSCL 20C

Equations are given for calculating circulation in the presence of Hall currents, based on the assumption that the electric field and the magnetic field are related to the density of the electric field. These equations are further extended to obtain quantitative estimates, and the calculations are tabulated. Results show that in the outer layers of the spot the magnetic field is comparable to H_0, and that the Hall currents are substantial; the field increases with the depth, but H_0 also increases. In the absence of Hall currents, the electric field in the spot is horizontal, and is directed at each point along a circle with its center on the axis of the spot. In the presence of Hall currents, there appears a radial component of the electric field, which does not exceed a few hundredths of a volt per centimeter; therefore, it cannot produce a Stark effect.
M.G.J.

N65-32991# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaries.
ELECTRON PROBE MICROANALYSER: STUDY OF THE FLUORESCENCE EXCITED BY CONTINUOUS RADIATION [MICROANALYSEUR A SONDE ELECTRONIQUE: ETUDE DE LA CORRECTION DE FLUORESCENCE DUE AU SPECTRE CONTINU]
Jean Henoc, Francoise Maurice, and Alexis Kirianenko Apr. 1964 65 p refs In FRENCH; ENGLISH summary
(CEA-R-2421) CFSTI: HC $3.00/MF $0.75

In order to permit the estimation of the correction due to fluorescence excited by continuous radiation, we have, on the one hand, determined experimentally on a set of pure elements the ratio of the fluorescent emission to the total characteristic radiation leaving the specimen and, on the other hand, calculated on the same elements the intensity of fluorescence excited by continuous radiation by means of a formula already established by one of us. The complicated part of this formula has been previously calculated on an I.B.M. computer. A few examples of fluorescence calculations are given to illustrate the use of the values obtained. Author

N65-32999# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
FORCED CONVECTION OF LIQUID HYDROGEN. FIRST PART: THE CASE OF A LOW TEMPERATURE DIFFERENCE BETWEEN THE LIQUID AND THE WALL [CONVECTION FORCEE DE L'HYDROGENE LIQUIDE. PREMIERE PARTIE: CAS DE FAIBLES ECARTS DE TEMPERATURES ENTRE FLUIDE ET PAROI]
Paul Perroud and Jean Rebiere Sep. 1964 39 p refs In FRENCH; ENGLISH summary
(CEA-R-2439) CFSTI: HC $2.00/MF $0.50

Measurements have been performed in a smooth inconel tube of 3 mm ID, 3.5 mm OD, electrically heated (DC) along 300 mm of its length. The liquid enters the test section subcooled at a constant temperature of 20.3° K. Pressure varied from 2 to 16 atm, mass velocity from 5 to 35 g/cm^2-s giving Reynolds numbers from 20,000 to 100,000. A formula of correlation for the heat transfer coefficients is given for the homogeneous liquid phase. Burn-out phenomenon is seriously affected by flow oscillations. Effect of mass velocity and pressure on burn-out heat fluxes is discussed. Pressure drops can be calculated by considering the variation of momentum in a one-dimensional model. Head losses due to friction are negligible. Author

N65-33028# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucléaires.
FORCED CONVECTION OF LIQUID HYDROGEN. PART II: CASE OF LARGE TEMPERATURE DIFFERENCES BETWEEN THE FLUID AND THE WALL (CYLINDRICAL CHANNEL) [CONVECTION FORCEE DE L'HYDROGENE LIQUIDE. 2EME PARTIE: CAS DE GRANDS ECARTS DE TEMPERATURES ENTRE FLUIDE ET PAROI (CANAL CYLINDRIQUE)]
Final Report
Paul Perroud and Jean Rebiere Oct. 1964 62 p refs In FRENCH; ENGLISH summary
(CEA-R-2499) CFSTI: HC $3.00/MF $0.75

Measurements have been performed in a smooth Inconel tube electrically heated by Joule effect. The liquid enters the test section subcooled at the constant temperature of 25° K average; then it is heated till, most often, complete vaporization. The conditions are: inlet pressure (subcritial) 8 atm (a number of experiences have been made under supercritical pressure of 16 atm), mass velocity 11 to 115 g/cm^2-s, heat flux density 9 to 385 W/cm^2, wall temperature reaching 800° K. The liquid hydrogen used was composed of about 60 percent of para-hydrogen (the transformation para-ortho does not happen in the process). A flow model, connected with the wall temperatures observed, is established. In the region of two-phase flow, the wall temperature highly decreases and passes through a minimum just when the steam quality reaches unity. Author

N65-33040# Gt. Brit. Ministry of Aviation, Nottingham. Technical Information and Library Services.

MECHANICAL OSCILLATIONS IN A VARIABLE TEMPERATURE FIELD [MEKHANICHI KOLIVANNYA V ZMINNOMU TEMPERATURNOMU POLI]

M. V. Vasylenko and O. Yu. Klikh Aug. 1965 6 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Ukr. RSR (Kiev), v. 5, 1963 p 592–595

(TIL/T-5576) CFSTI: HC $1.00/MF $0.50

An analysis is given for the simple case of a heavy body oscillating on the end of a rod of negligible mass, a one-degree-of-freedom system. The temperature is varied over a given range. The results are worked out on an electronic computer. Author

N65-33047# National Aeronautical Lab., Bangalore (India).

PRELIMINARY STUDIES OF NOISE PATTERNS FROM SUBSONIC TWIN-JETS

B. R. Somashekar and Y. V. G. Acharya Feb. 1965 38 p refs (TN-AE-65) CFSTI: HC $2.00/MF $0.50

Measurements have been made of the noise emanating from two jets, 50 cm apart, each issuing from 1 cm diameter convergent nozzles, at atmospheric temperature and at a high subsonic speed. The results presented give the increase in sound energy due to the addition of a jet as a function of the angle measured from the center of the line joining the two jets and parallel to the jet axis. Some shielding of one jet by the other is noticed in certain frequency bands but to know more about the attenuation of sound by the interaction of turbulent jets, which is of practical interest, requires further theoretical and experimental investigations and these are in progress. Author

N65-33051* Vanderbilt Univ., Nashville, Tenn. Dept. of Mathematics.

NECESSARY CONDITIONS FOR A MULTISTAGE BOLZA-MAYER PROBLEM INVOLVING CONTROL VARIABLES AND HAVING INEQUALITY AND FINITE EQUATION CONSTRAINTS

M. G. Boyce and J. L. Linnstaedter *In* NASA. Marshall Space Flight Center Studies in the Fields of Space Flight and Guidance Theory 12 Jul. 1965 p 7–31 refs (See N65-33050 21-30) CFSTI: HC $7.88/MF $2.50

A multiplier rule and analogues of the Weierstrass and Clebsch conditions are developed for a multistage Bolza-Mayer calculus of variations problem. The number of stages is fixed, but partition points defining stage boundaries are variable. Discontinuities are allowed in variables and constraint functions at partition points. The constraints include finite equations and inequalities, as well as differential equations, all of which involve control variables. Author

N65-33053* Analytical Mechanics Associates, Inc., Uniondale, N. Y.

AN ENSEMBLE AVERAGING APPROACH TO OPTIMAL GUIDANCE POLYNOMIAL APPROXIMATIONS

Henry J. Kelley and Walter F. Denham *In* NASA. Marshall Space Flight Center Studies in the Fields of Space Flight and Guidance Theory 12 Jul. 1965 p 65–87 refs (See N65-33050 21-30) CFSTI: HC $7.88/MF $2.50

(Contract NAS8-11241)

An approach to optimal guidance synthesis is developed in which an ensemble-averaged second order approximation to the performance function is minimized subject to constraints on the means and variances of other functions. The minimization is with respect to coefficients of assumed polynomial approximations of a linear feedback control law (in which the state is perfectly known) and coefficients in a linear termination law. A brief comparison is drawn with deterministic neighboring extremal control. While attention is directed mainly to first order necessary conditions, some comments are made on numerical solution by first and second order successive approximation methods. Extensions to include disturbances other than initial errors and to include state estimation errors are discussed briefly. Author

N65-33152# California Univ., Los Angeles. Dept. of Physics.

THEORY OF A CONFIGURATIONAL EMF

Marvin Chester 1963 29 p refs Sponsored by ONR (AD-617610)

A configurational emf refers to an electrical manifestation in the electron gas of the analogue of the Bernoulli effect for fluid flow. A theoretical account of this phenomenon is given. The object of the theory is to present a description of the effect from first principles which in this instance is taken as the Boltzmann transport equation. The transport equation is solved for a two band (holes and electrons) Fermi particle system. The solutions are carried beyond first order so as to exhibit the effect. It is shown that the form of the emf is, indeed, extractable from the Boltzmann equation. And is magnitude is obtained in terms of a coefficient C for which a formula is given in terms of familiar current carrier parameters. Author

N65-33158# Commissariat a l'Energie Atomique, Saclay (France).

POSSIBILITY OF APPLYING THE GAMMA–GAMMA METHOD IN THE IN SITU DETERMINATION OF URANIUM ORE DENSITIES [LES POSSIBILITES D'APPLICATION DE LA METHODE GAMMA–GAMMA A LA DETERMINATION EN PLACE DE LA DENSITE DES MINERAIS D'URANIUM]

Jan Czubek (Inst. of Nucl. Res., Krakow) and Jean Guitton Mar. 1965 18 p refs In FRENCH

(CEA-R-2720) CFSTI: HC $1.00/MF $0.50

The possibility of applying the gamma–gamma method to the density measurement of uranium rock embedded in the earth is considered. The gamma–gamma method utilizes the diffusion of gamma rays in conjunction with a detecting device. It yields measurements of the electronic density of the rock, $n_e(el/cm^3)$ rather than its mass density. Experimental results show that application of the gamma–gamma method is possible under certain conditions which include: avoiding the influence of the variation in chemical composition of the uraniferous rock, obtaining a true value for the electronic density of the rock, using a precisely constructed gamma–gamma source, and considering systematic error in final calculations. Transl. by G.A.L.

N65-33164# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.

FINE MEASUREMENTS IN GRAPHITE LATTICES [MESURES FINES DANS DES RESEAUX A GRAPHITE]

Francois Cogne and Jacques Journet 1964 54 p refs In FRENCH

(CEA-R-2479) CFSTI: HC $3.00/MF $0.50

Calculations and experimental results are given for fine measurements in a graphite–uranium lattice. Structural measurements, determined by Marius using a classical detection method, are presented and interpreted. Principles for the measurement of spectral indices are discussed, and a comparison of Pu/U and In/Mn index measurements with theoretical calculations is made. Results show that there is good agreement between theoretical calculations and experimental measurements in Pu/U and In/Mn indices, while there appears to be a small percentage error in a comparison of figures for In/Mn indices in a combustible state. Transl. by G.A.L.

N65-33254*# Harvard Coll. Observatory, Cambridge, Mass.
MULTIPLE SCATTERING BY LARGE PARTICLES
William M. Irvine 1965 30 p refs
(Grant NsG-89-60)
(NASA-CR-64638) CFSTI: HC $2.00/MF $0.50 CSCL 20F

The Neumann solution to the scalar equation of transfer in a homogeneous layer of optical thickness $\tau^* \leq 1$ is obtained numerically for sample phase functions with large forward and backward peaks. The results are presented graphically and are compared with the intensities and albedos computed by several approximate methods. Author

N65-33255*# Research Inst., Chicago, Ill. Technology Center.
INVESTIGATION OF LIGHT SCATTERING IN HIGH REFLECTING PIGMENTED COATINGS Quarterly Report, 1 May–1 Aug. 1965
G. A. Zerlaut, B. H. Kaye, S. Katz, and V. Raziunas 9 Aug. 1965 56 p refs
(Contract NASr-65(07))
(NASA-CR-64619; IITRI-C6018-15) CFSTI: HC $3.00/MF $0.50 CSCL 20F

The adaptation of classical Mie theory to multiple scattering has been extended to different refractive indices using the radial scattering data of Lowan. The concentrations of 1-micron particles and film thicknesses required to attenuate an incident source to 1% was calculated. The random-walk investigations involve a description of random intercepts of a circle, the development of the concept of randomly superimposed screens, and preliminary studies of a Monte Carlo approach to the simulation of sections through paint films. It is shown by the use of randomly superimposed screens that a body composed of 50% solids will permit only 0.7% of the incident light to pass through 7 equivalent screens. The implications of this concept are discussed. The experimental studies during this period resulted in the generation of an equation which relates reflectance to the thickness of pigmented films:

$$\frac{1}{100-R_\lambda} = C_2 t C_1$$

where R_λ is the spectral reflectance at wavelength λ, t is the thickness and C_1 and C_2 are constants applicable at wavelength λ. Author

N65-33273# Aeronautical Research Council (Gt. Brit.).
NOTES ON THE ANALYSIS OF STABILITY IN ACCELERATED MOTION
S. B. Gates and A. W. Thorpe London, Min. of Aviation, 1965 69 p refs Supersedes RAE-AERO-2526; ARC-17129
(REM-3394; RAE-AERO-2526; ARC-17129)

Linear differential equations whose coefficients are functions of the independent variable are now assuming importance in aeronautics in the discussion of the motion following a small disturbance in a specified accelerated motion. In such problems the undisturbed state is often a transition motion in a limited time interval between two steady motions and we are concerned to see that the disturbed motion does not exceed tolerable bounds in a limited time. The extension of classical stability theory to such problems involves some logical difficulties and very great mathematical ones, since such equations are seldom soluble algebraically. For these reasons an indirect attack on the problem is made here by seeking to establish upper bounds to the solution of second-order equations, which are those most commonly occurring. The subject is introduced by a study of the equation

$$\ddot{x} + b(t)x + c(t)\dot{x} = 0.$$

The theory is then applied to a simple problem of pitching motion in an airstream of varying velocity. Finally a system of two second-order equations involving two variables x and y is discussed from this angle. This system is not tractable in its most general form, but the special cases that yield to treatment are those which have occurred in some recent problems. Author

N65-33330# Stanford Research Inst., Menlo Park, Calif.
TRIBOELECTRIC CHARGING OF A SUPERSONIC BODY Interim Engineering Report
J. E. Nanevicz, W. C. Wadsworth, and J. A. Martin May 1965 28 p refs
(Contract AF 33(615)-1934)
(IER-3; AD-466795)

Triboelectric charging of 5/32-inch-diameter steel balls have been measured at speeds from 1800 ft/sec to 4000 ft/sec. The projectiles were charged by passing through an ice fog generated in an environment chamber at −55° C. Ice crystals are estimated to be roughtly 2 microns in diameter. Preliminary explanations are offered for the observed decrease in charging with increasing speed. Author

N65-33351*# National Aeronautics and Space Administration. Langley Rearch Center, Langley Station, Va.
NOISE STUDIES OF INLET-GUIDE-VANE–ROTOR INTERACTION OF A SINGLE-STAGE AXIAL FLOW COMPRESSOR
John L. Crigler and W. Latham Copeland Washington, NASA, 40 p refs
(NASA-TN-D-2962) CFSTI: HC $2.00/MF $0.50 CSCL 20A

Some experimental results are presented of a noise study of a single-stage axial-flow compressor. The objective of the study was to investigate the effect of inlet-guide-vane rotor interaction on the noise radiation patterns in the far field with a view toward alleviating the noise at its source. A variable-speed electric motor was used to drive the compressor rotor through a range of tip Mach numbers from 0.20 to 0.50. The test setup was arranged so that the number of inlet guide vanes could be varied and the vanes of each unit could be adjusted to give varying blade loading. Provisions for axial spacing of the rotor and guide vanes were made with the use of spacer rings. The data are presented in the form of noise radiation patterns and frequency spectra. These data show how the radiation patterns are affected by the relative number of rotor blades and guide vanes. Calculations of radiation patterns were made for comparison with the experimental data, and good qualitative agreement was obtained. Author

N65-33439# Illinois Univ., Urbana. Charged Particle Research Lab.
STATIC AND DYNAMIC BEHAVIOR OF LIQUID DROPS IN ELECTRIC FIELDS
Steven B. Sample Jun. 1965 81 p refs Sponsored by NSF
(CPRL-7-65)

The problem considered is the behavior of an uncharged, conducting liquid drop in a uniform electric field. The liquid is assumed to be homogeneous, non-viscous, and incompressible. The shape of the drop is expressed as an infinite series of Legendre polynomials, and expressions, correct to second order in the Legendre polynomial coefficients, are obtained for the surface tension potential energy and electrostatic potential energy of the system. The total system potential energy is then minimized with respect to variations in the coefficients, thereby yielding the equilibrium shape of the drop in a d-c field. This theoretically predicted drop distortion is shown to be in close agreement with all experimental data. The coefficients are then considered to be time varying, and a

second order expression for the kinetic energy of the liquid is obtained. This expression is combined with the total potential energy to yield the Lagrange formulation of the equations of motion for the coefficients. Author

N65-33444# Southwest Research Inst., San Antonio, Tex. Dept. of Applied Physics.
STUDY OF AIRBORNE NOISE FROM SHIPBOARD MACHINERY Final Technical Report, Jun. 20, 1963–Jun. 19, 1964
Cecil R. Sparks, Richard A. Mc Coy, and J. C. Wachel 19 Jun. 1964 241 p refs
(Contract NObs-88636)
(AD-461615)

A comprehensive survey of noise in combatant ships shows that airborne sound levels generated by machinery items are above specifications in several shipboard spaces. Although absolute noise evaluation of individual machines is difficult while underway, dockside tests can be used to define such characteristics for most such items. These characteristics are discussed and compared, and total environmental noise conditions are evaluated on individual and statistical basis for various machinery and personnel spaces. Existing noise conditions at sea and dockside are compared to applicable habitability criteria, together with an analysis of reported effects of sound on personnel. Several types of shop noise tests are useful for studying noise from machinery items prior to installations. While limitations exist in using such data for predicting actual installed levels, with proper mounting, measurement and test environment, these tests can be used for comparing items and perhaps for qualifying equipment on a noise basis. Author

N65-33456# Witwatersrand Univ., Johannesburg (Union of South Africa). Dept. of Mechanical Engineering.
A NEW TREATMENT OF THE TRANSIENT RESPONSE OF THE VISCOUSLY-DAMPED SINGLE-DEGREE-OF-FREEDOM SYSTEM
K. Posel Jun. 1963 20 p refs Presented at the 5th Intern. Symp. on Space Tech. and Sci., Tokyo, 1963
(Rept.-17) CFSTI: HC $1.00/MF $0.50

The nature of the step function required for description of transient response in a linear single-degree-of-freedom system is studied. The study is based on the observed overshoots in data from a capacitance transducer which senses the pressure waveform generated by a shock tube; this phenomenon could not be fully explained by the usual assumption of a zero time interval for the discontinuities in the step function, and required allowance for time intervals greater than zero. It is shown that this time for going from one step up to the next must be quite small, compared to the natural period of the wave system, before the simplifying concept of the zero interval can be justified. J.M.D.

N65-33477# Rochester Univ., N. Y. Inst. of Optics.
A STUDY OF THE WAVE INTERACTION BETWEEN LIGHT BEAMS HAVING LARGE PATH DIFFERENCE Final Report, Jun. 1, 1962–Sep. 30, 1964
M. Parker Givens 10 Jan. 1965 23 p refs
(Contract AF 19(628)-465)
(AFCRL-65-150; AD-614998)

The work reported here has been directed toward an experiment to measure the velocity of light using a well regulated thermal light source such as a Mercury 198 isotope lamp and depending upon the random fluctuations of the source to substitute for the usual modulation (e.g. toothed wheel). In such an experiment the signal to noise problem is very severe and our major effort has been to consider possible ways of overcoming this difficulty. Aside from the primary considerations we have carried out two side investigations. First we have demonstrated that the beating between modes of a continuously operating gas laser serves to modulate the intensity and thus enables one to measure the velocity of light without any other modulating device. Second, we have devised and tested a new technique for measuring the variation in time of flight of electrons through a photomultiplier as a function of the cathode position from which they are emitted. Author

N65-33481# Edo Corp., College Point, N. Y.
THE EQUILIBRIUM CONFIGURATION OF A TOWED HYDROFOIL-CABLE SYSTEM IN TWO-DIMENSIONAL STEADY TURNS
P. A. Pepper 10 Jan. 1964 53 p refs
(Contract Nonr-3582(00))
(EDO-5822; AD-600068)

This report describes a method for calculating the equilibrium configuration of a cable-towed hydrofoil system when the entire system rotates (as a rigid body) with constant angular velocity in the plane of the towpoint motion, the bulk of the analysis applying to the case of massless elements (cable and hydrofoil). This is done by obtaining an explicit solution (first integral) for the differential equation for the cable curve, from which the cable arc length and polar angle can be obtained by quadratures relative to the radius vector. Owing to the "indirect" nature of this problem, i.e., the requirement of satisfying two boundary conditions at an initially unknown boundary point, solution of any given problem involves certain numerical calculations. The latter have been considerably facilitated by construction of a set of numerical tables for the principal non-dimensional quantities. Illustrative numerical examples reveal a number of remarkable characteristics of such systems. One of these is the presence, under certain conditions, of inflection points in the cable curves. More fundamental is a set of (related) characteristics similar to those of strut-towed hydrofoil systems. Author

N65-33517# Innsbruck Univ. (Austria). Dept. of Theoretical Physics.
ON THE CONSERVATION LAW OF ANGULAR MOMENTUM GENERAL RELATIVITY Special Scientific Report No. 10
P. Unteregger 13 Jul. 1964 15 p refs
(Contract DA-91-591-EUC-2682)
(AD-461068) CFSTI: HC $1.00/MF $0.50

General remarks, superpotentials, and derivations are given on the conservation law of angular momentum in general relativity. Derivations are given without considering the spin and by the method of superpotentials. A derivation is also included for the conservation law of angular momentum for the electron gravitational field with spin in general relativity. C.T.C.

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N65-32397*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INFLUENCE OF OPPOSING SLITS ON MOLECULAR FLOW FROM AN ISOTHERMAL ENCLOSURE AT LOW DENSITIES
Eugene J. Manista and John W. Sheldon Washington, NASA, Sep. 1965 21 p refs
(NASA-TN-D-2986) CFSTI: HC $1.00/MF $0.50 CSCL 20H

A direct particle density measurement of cesium vapor in an isothermal enclosure is described. A surface ionization detector is used to determine the particle flux issuing through a narrow slit in the enclosure. The effect of a second slit located in the rear wall of the enclosure and directly opposite the emitting slit is investigated quantitatively, and the results are analyzed in terms of a hypothetical "hole emission" from the second slit. The attenuation of the "hole" beam is used to determine a cesium-cesium cross section. The result is compared with a previously published cross section obtained by more conventional techniques. Author

N65-32448* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THEORY OF IONIZATION OF ATOMIC SYSTEMS BY HIGH-INTENSITY RADIATION
O. von Roos *In its* Space Progfams Sum. No. 37–33, Vol. IV 30 Jun. 1965 p 196–199 ref (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

A theory is developed for the ionization process of atomic systems using perturbation theory. The wave function of the electron is given and the transition probability per second due to the incident radiation is derived. The estimate was checked against exactly calculated values for the two-photon ionization of excited hydrogen. It was found that the estimate turns out to be the right order of magnitude in this case. E.E.B.

N65-32449* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
INTERACTION OF INTENSE ELECTROMAGNETIC BEAMS WITH ELECTRON BEAMS
N. M. Saffren *In its* Space Programs Sum. No. 37–33, Vol. IV 30 Jun. 1965 p 199–201 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

A perturbation method for handling the problem of bound and free electrons is proposed which uses the Feynman propagator in the perturbation expansion of the electron wave function. In the method there appears no problem with the boundary conditions at infinity. The approach allows the writing of the S matrix in any particular order of the fine structure constant without first solving an initial-value problem. Moreover, no difficulty is experienced in treating problems in which there is more than one intense beam present. It is assumed that the radiation field is unquantized. The matrix elements which are derived can be calculated using the usual Feynman rules except that in each term in which an intense photon appears, the term is multiplied by the square root of the number of photons in the beam as many times as the intense photon term appears. E.E.B.

N65-32455* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ON THE CORRELATION OF GEMINAL AND VICINAL NUCLEAR MAGNETIC RESONANCE SPIN-SPIN COUPLING CONSTANTS WITH SUBSTITUENT ELECTRONEGATIVITIES
S. L. Manatt and D. D. Elleman *In its* Space Programs Sum. No. 37–33, Vol. IV 30 Jun. 1965 p 220–224 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

An analysis is made which demonstrates for one series containing three-membered ring molecules that there does exist a very simple linear relation between geminal and vicinal proton–proton coupling and the Huggins electronegativity and that this relation is better than previous similar correlations show. The reason for the scatter in the previously offered correlations is the fact that certain substituents possess electronic interactions whose presence does not contribute measureably to the determination of bond energies from which electronegativities are derived but whose presence does provide additional possibilities for the propagation of nuclear spin–spin coupling. This may mean that in many cases the ^{13}C–H coupling does not directly measure the percentage s character in a carbon bonding orbital when a carbon atom is substituted by one of the type of substituents capable of these electronic effects. E.E.B.

N65-32456* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE F NMR SPECTRA OF THE TRIFLUOROACETATES OF POLY (ALKYLENE OXIDES)
S. L. Manatt, D. D. Lawson, and J. D. Ingham *In its* Space Programs Sum. No. 37–33, Vol. IV 30 Jun. 1965 p 224–227 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

Results are described which demonstrate that the asymmetric carbon atoms present in the propylene oxide monomer units are the origin of the doublet ^{19}F nuclear magnetic resonance signals observed for the trifluoroacetate esters of the polypropylene oxide polymers. The high field member of the doublet was identified as belonging to the isotactic diad end-group units. Also, results suggest that the polymers obtained by $FeCl_3$ catalyzed polymerization of racemic propylene oxide are primarily isotactic. Also, the technique used can be a convenient means of determining the relative amounts of various types of hydroxyl end-groups present in polyalkylene oxides. It appears that this technique may be of significant value in predicting the reactivity and applicability of these polymers for propellants and spacecraft materials. E.E.B.

N65-32488 Lincoln Lab., Mass. Inst. of Tech., Lexington.
EXPERIMENTS ON ENERGY BANDS IN SOLIDS
Benjamin Lax *In* AGARD Advan. in Mater. Res. in the NATO Nations 1963 p 247–279 refs (See N65-32475 21-26) CFSTI: HC $8.35/MF $2.50

There are many techniques for investigating the band structure of solids. The gavanomagnetic effects, perhaps the oldest of the methods, are useful for initial exploratory studies. For metals, more detailed information is obtained from the de Haas–van Alphen effect, cyclotron resonance and magneto-acoustic resonance. In the semiconductors where cyclotron resonance has been obtainable, this method has provided the most complete results. For many materials, cyclotron resonance is not possible either because of too much scattering or because of plasma effects; it is then necessary to resort to other techniques of which the magneto-optical experiments appear the most promising. These experiments when performed at low temperatures on pure materials, with high magnetic fields of the order of a hundred kilogauss, and using advanced millimeter, far infrared and optical spectroscopic techniques should provide us with a new wealth of information on the band structure of solids. Author

N65-32565 Tokyo Univ. (Japan). Dept. of Physics.
BEHAVIOR OF SLOW ELECTRONS IN ATMOSPHERIC GASES. PART I: GENERAL CONSIDERATION OF ROTATIONAL EXCITATION AND APPLICATION TO THE OXYGEN MOLECULE
Kazuo Takayanagi *In* Sci. Council of Japan Rept. of Ionosphere and Space Res. in Japan, Vol. 19, No. 1 Mar. 1965 p 1–15 refs (See N65-32564 21-29)

Effective cross-sections for the rotational transition of an oxygen molecule by slow electrons (<2 eV) are calculated by using the Born approximation. Validity of the approximation is discussed. The resulting cross-sections are used to evaluate the stopping power of oxygen for slow electrons. Author

N65-32566 Tokyo Univ. (Japan). Dept. of Physics.
BEHAVIOR OF SLOW ELECTRONS IN ATMOSPHERIC GASES. PART II: ROTATIONAL EXCITATION OF THE NITROGEN MOLECULE
Kazuo Takayanagi *In* Sci. Council of Japan Rept. of Ionosphere and Space Res. in Japan, Vol. 19, No. 1 Mar. 1965 p 16–20 refs (See N65-32564 21-29)

The specific stopping power of the nitrogen molecule for slow electrons due to rotational excitation is calculated. It is based on the cross-section calculated by Takayanagi and Geltman using the distorted wave method. It is found that the stopping power of nitrogen is an order of magnitude larger than that of oxygen calculated in Part I. Author

N65-32586 Joint Publications Research Service, Washington, D. C.
INSTRUMENTS FOR RADIATION DETECTION AND MEASUREMENT
K'o Shih *In its* Transl. on Communist China's Sci. and Technol., No. 210 25 Aug. 1965 p 1–6 Transl. into ENGLISH from K'o-Hsueh Ta-chung (Peking), no. 7, 5 Jul. 1965 p 8–9 (See N65-32585 21-34) CFSTI: $2.00

The principles of various kinds of detectors of nuclear rays and particles are summarized. The functions and particular advantages of gas-filled ionization chambers, scintillation counters, semiconductor counters, cloud and bubble chambers, and emulsions are discussed. Each type of instrument serves to detect or measure radiation quantities of electrons, protons, neutrons, neutrinos, or gamma rays. J.M.D.

N65-32589 Chicago Univ., Ill. Inst. for Computer Research.
AUTOMATIC RETRIEVAL SPARK CHAMBERS
J. Bounin, R. H. Miller, and M. J. Neumann *In its* ICR Quart. Rept., No. 5 1 May 1965 83 p refs Submitted for Publication (See N65-32588 21-08)

The state-of-the-art of automatic retrieval spark chambers for the detection of nuclear particles is discussed and a comparison of automatic retrieval versus photographic recording is given. The advantage of a computer in a spark chamber system is on-line operation that permits modification of an experiment as it proceeds. Several spark chamber experiments using a Maniac III computer are described. G.G.

N65-32597*# Electro-Optical Systems, Inc., Pasadena, Calif.
ANALYTICAL AND EXPERIMENTAL STUDIES OF SURFACE IONIZATION **Final Report, 24 Jan.–30 Sep. 1964**
W. D. Dong 1 Sep. 1965 53 p refs
(Contract NAS3-5244)
(NASA-CR-54126; EOS-4761-Final) CFSTI: HC $3.00/MF $0.50 CSCL 20H

Analytical studies and experimental measurements were made which resulted in the conclusion that rhodium and rhenium are better cesium-ionizer materials than tungsten for surface ionization engines. Other materials evaluated were iridium, tantalum, 74% tungsten-26% rhenium and 10% tungsten-90% tantalum. The conclusion was primarily based on an evaluation of critical temperature, work function and ionization efficiency. Also measured were atom and ion lifetimes and atom and ion desorption energies. Author

N65-32615# Kansas Univ., Lawrence.
SYMPOSIUM ON THE STRUCTURE OF LOW-MEDIUM MASS NUCLEI
L. W. Seagondollar, ed. [1964] 223 p refs Symp. held at Kansas Univ., 5–6 Mar. 1964; Sponsored in Cooperation with Aerospace Res. Labs., Wright-Patterson AFB, Ohio
(ARL-65-63; AD-616242)

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4. ANGULAR CORRELATION MEASUREMENTS AND PROPERTIES OF P^{31} G. I. Harris (AF Sys. Command) p 39–79 refs (See N65-32619 21-24)

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7. ROTATIONS AND VIBRATIONS IN LIGHT NUCLEI J. P. Davidson (Rensselaer Polytechnic Inst.) p 143–164 refs (See N65-32622 21-24)

8. SHELL MODEL STUDIES IN THE NUCLEAR (2s, 1d)-SHELL M. Harvey (Atomic Energy of Canada) p 165–181 refs (See N65-32623 21-24)

9. STUDIES OF THE GIANT DIPOLE RESONANCES WITH (p, r) REACTIONS S. S. Hanna (Stanford Univ.) p 182–218 refs (See N65-32624 21-24)

N65-32616 Utrecht State Univ. (Netherlands).
PROPERTIES OF SOME NUCLEAR STATES IN THE A = 28–40 REGION
P. M. Endt *In* Kansas Univ. Symp. on the Struct. of Low-Medium Mass Nuclei [1964] p 1–2 refs (See N65-32615 21-24)

Theoretical work was reviewed in which the states considered were an inert Si^{28} core plus one or more nucleons in the $2s_{1/2}$ and/or $1d_{3/2}$ shells. Results showed that the interaction matrix elements can be reduced to linear expressions in 15 two-particle interactions and 2 binding energies to the core. Best values for these 17 parameters were obtained from a least-squares fitting procedure, in which computed energies were compared with the energies of 50 states with well known spin and isospins. Theoretical and experimental level schemes for A = 31, 32, 33, 35, and 38 are graphically compared to show the degree of agreement obtained, and particular levels which were investigated are discussed. Shell-model calculations of these nuclei are also discussed, and experiments, undertaken to check the predictions from some of the calculations, are described. M.G.J.

N65-32617 State Univ. of New York, Stony Brook.
COLLECTIVE EFFECTS IN Ca^{41}
J. B. Raz *In* Kansas Univ. Symp. on the Struct. of Low-Medium Mass Nuclei [1964] p 13–21 refs (See N65-32615 21-24)

Experimental data on Ca^{41} are reviewed, and the problems of why the single-particle level splits into two fragments, and of why the E2 transition probability is so large for the 1.95 MeV state, and so small for the 2.47 MeV state are investigated. The core plus particle theory is used; here a Hamiltonian is assumed for the scalar product of two tensors, with one operating on the core coordinates, and the other on the single-particle coordinates. The γ-ray transitions are considered by expanding the electromagnetic operators in terms of the core + particle. The equation for the reduced matrix element for the E2 transition is given, with each term written as a core core term + a particle particle term. Using the experimental data, a consistent picture emerges with the small transition from the 2.47 MeV state correlated to the (d,p) results and the large transition from the 1.95 MeV state. Collective enhancement methods are discussed, and experiments to measure the collective effects are suggested. Results of the analysis show that the interaction Hamiltonian is enhanced even more than the E2 transition matrix elements. M.G.J.

N65-32618 Physical Research Lab., Ahmedabad (India).
EFFECTIVE INTERACTIONS AND COUPLING SCHEMES IN NUCLEI
S. P. Pandya *In* Kansas Univ. Symp. on the Struct. of Low-Medium Mass Nuclei [1964] p 22–38 (See N65-32615 21-24)

In developing a simple model to determine nuclei interactions, three parameters were used to produce a large variety of coupling schemes, and to examine the change in the level spectrum with changes in these parameters. In the case of the 1s, 0d shell, the two-particle wave functions involve only three s-states: 0s, 1s, and 2s. Therefore, all two-particle matrix elements can be expressed in terms of three Talmi integrals, I_{0s}, I_{1s}, and I_{2s}. Different values are given for these arbitrary parameters, and various coupling schemes are obtained. Data are graphically depicted for energy levels of two nucleons in a L–S coupling scheme; energy level schemes for T = 0 and T = 2 states of four-particle configurations; and energy levels of two nucleons in the T = 1 and T = 0 states, and of four nucleons in the T = 2 and T = 0 states, including spin orbit interactions. M.G.J.

N65-32619 Air Force Systems Command, Wright-Patterson AFB, Ohio. Aerospace Research Labs.
ANGULAR CORRELATION MEASUREMENTS AND PROPERTIES OF P^{31}
Gale I. Harris *In* Kansas Univ. Symp. on the Struct. of Low-Medium Mass Nuclei [1964] p 39–79 refs (See N65-32615 21-24)

Experimental studies on states of P^{31}, in which the proton capture reaction and angular correlation methods were used, are discussed. Measurements to determine the spins, parities, and/or decay properties of five low-lying states in P^{31} are also described. These include angular correlation formulation and the $Si^{30}(p,\gamma)P^{31}$ reaction; the 3.13 MeV level and ambiguity theorems; the 3.29 MeV level and relative phases of mixing ratios; the 3.41 MeV level and its spin and parity; the 3.51 MeV level and determination of temporal order in cascades; and the 4.43 MeV level and a linear polarization measurement. Figures are included to illustrate the data. M.G.J.

N65-32620 Oslo Univ., Blindern (Norway).
PROTON CAPTURE REACTIONS IN ^{27}Al
Rolf Nordhagen *In* Kansas Univ. Symp. on the Struct. of Low-Medium Mass Nuclei [1964] p 80–108 ref (See N65-32615 21-24)

The microscopic approach used to study the $Al^{27}(p,\gamma)Si^{28}$ reaction is described, and a survey of Al^{27} resonances is reported. Studies of the 1118 keV resonance indicated an absence of transitions above 8 MeV, and a number of strong, low energy lines. The resonance corresponds to an excited level in Si^{28} at 12.67 MeV, which decays strongly to the 8.41 MeV state. Angular correlations and spin assignments analyses are detailed; and the correlations of the γ r, s through various states, and the decay schemes of different resonances in the reaction are plotted. The Si^{28} experiments showed that odd parity states decay primarily to odd parity states; even parity states decay preferentially to even parity states. It was also noted that when an odd parity level is excited with reasonably high spin, several states not normally excited in the majority of even parity resonances appear. M.G.J.

N65-32621 Utrecht State Univ. (Netherlands).
ALPHA-CAPTURE REACTIONS IN TRANS-NEONICS
C van der Leun *In* Kansas Univ. Symp. on the Struct. of Low-Medium Mass Nuclei [1964] p 109–142 refs (See N65-32615 21-24)

To obtain information on trans-neonic nuclei, radiative alpha-capture reactions were investigated. Experiments were conducted to obtain data on reaction cross sections; excitation energies, spins, and parities of resonance levels; and quadrupole/dipole mixing ratios of gammas de-exciting the resonance levels. Results of the most pertinent findings are plotted. A survey of radiative widths of E1, M1, and E2 transitions in $20 < A < 40$ nuclei yielded values for the most likely a priori strengths of E1, M1, and E2 transitions in sd-shell nuclei, and showed evidence for the isospin inhibition of both E1 and M1 radiation in self-conjugated $20 < A < 40$ nuclei. A very pronounced A-dependence of E1 transition strengths was found, and a similar but less pronounced dependence for M1 transitions was observed. M.G.J.

N65-32623 Atomic Energy of Canada, Ltd., Chalk River (Ontario).
SHELL MODEL STUDIES IN THE NUCLEAR (2s,1d)-SHELL
M. Harvey *In* Kansas Univ. Symp. on the Struct. of Low-Medium Mass Nuclei [1964] p 165–181 refs (See N65-32615 21-24)

An independent particle model is described, and the types of assumptions made in such a calculation are reviewed. Results of calculations on the low-lying negative parity states of nuclei at the beginning of the 2s,1d shell are given, based on use of the Elliott SU_3 model. M.G.J.

N65-32624 Stanford Univ., Calif.
STUDIES OF THE GIANT DIPOLE RESONANCES WITH (p,γ) REACTIONS
S. S. Hanna *In* Kansas Univ. Symp. on the Struct. of Low-Medium Mass Nuclei [1964] p 182–218 refs (See N65-32615 21-24)

Single particle transitions that occur between harmonic oscillator levels are discussed. Two nuclei were studied: C^{12}, which closes the $p_{3/2}$ shell; and Si^{28}, which perhaps closes the $d_{5/2}$ shell. Results show that the resonance associated with the excited state of the nucleus is pushed up by an amount approximately equal to the excited state energy. Despite fluctuations, the angular distributions throughout the main dipole resonance region are fairly constant, indicating a single predominant configuration for the resonance. It was also noted

that the (p,γ) reaction is a rather special case for applying the theory of statistical fluctuations in the compound nucleus; however, the reaction $Al^{27}(p,\gamma)Si^{28}$ showed features of a statistical nature. It was concluded that the giant dipole resonance can be investigated in considerable detail with the (p,γ) process. M.G.J.

N65-32626# Chicago Univ., Ill. Lab. of Molecular Structure and Spectra.
[STUDIES IN MOLECULAR STRUCTURE AND WAVEFUNCTIONS] Technical Report, 1 Jan.–31 Dec. 1964 [1964] 372 p refs
(Contracts Nonr-2121(01); DA-11-022-ORD-3119; AF 19(604)-6662; AF 19(628)-2474; AF 33(657)-8891)
(AD-464661)

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6. RARE-GAS AND HYDROGEN MOLECULE ELECTRONIC STATES, NONCROSSING RULE, AND RECOMBINATION OF ELECTRONS WITH RARE-GAS AND HYDROGEN IONS R. S. Mulliken p 275–278 refs (See N65-32631 21-24)

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15. ISOTOPE SHIFTS AND THE VIBRATIONAL STRUCTURE IN SOME WEAKER SYSTEMS OF N_2 D. Mahon-Smith (Natl. Univ. of Ireland) and P. K. Carroll p 352–357 refs (See N65-32640 21-24)

16. SPECTRUM AND STRUCTURE OF THE MOLECULE. I. CHARACTERIZATION OF THE STATES ASSOCIATED WITH THE UAO'S $3p\sigma$ AND 2s M. L. Ginter p 358–365 refs (See N65-32641 21-24)

N65-32627 Argonne National Lab., Ill.
ANALYTIC SELF-CONSISTENT FIELD WAVEFUNCTIONS AND COMPUTED PROPERTIES FOR HOMONUCLEAR DIATOMIC MOLECULES
Arnold C. Wahl *In* Chicago Univ. [Studies in Mol. Struct. and Wavefunctions] [1964] p 74–92 refs Repr. from J. Chem. Phys., v. 41, no. 9, 1 Nov. 1964 p 2600–2611 (See N65-32626 21-24)
(Grant NSF GP-28)

Analytic self-consistent field (SCF) wave functions were computed for the ground states of the closed-shell atomic systems F^-, Ne, Na^+; and Cl^-, Ar, and K^+, and for those ground and excited states of the open-shell systems that are obtained by removing a single electron from any one of the occupied shells of these closed-shell systems. Details of the calculation of the functions are presented with emphasis on a justification of the procedures used for the calculations for excited states. A high accuracy is obtained; the calculations for the closed-shell systems give the most accurate analytic SCF wave functions that have yet been reported. Ionization potentials are calculated and compared with experimental values. Computed ionization potentials for the removal of a 2s electron from Cl^-, Ar, and K^+, for which no direct experimental data are available, are estimated to be accurate to within 1%. It is found that the removal of an electron from the outermost s shell increases the correlation energy, in contradiction to the predictions of a recently proposed semi-empirical scheme for estimating the correlation energy. Author

N65-32628 Chicago Univ., Ill. Lab. of Molecular Structure and Spectra.
THE ELECTRONIC STRUCTURE OF DIATOMIC MOLECULES. III. A: HARTREE-FOCK WAVE FUNCTIONS AND ENERGY QUANTITIES FOR $N_2(X\ ^1\Sigma_g)$ AND $N_2(X\ ^2\Sigma_g,\ A\ ^2\Pi_u,\ B^2\Sigma_u)$ MOLECULAR-IONS
Paul E. Cade, K. D. Sales, and Arnold C. Wahl *In its* [Studies in Mol. Struct. and Wavefunctions] [1964] p 93–191 refs (See N65-32626 21-24)
(Grant NSF GP-28)

The problem of the convergence of a sequence of Hartree-Fock-Roothaan wave functions and energy values to the true Hartree-Fock results is examined for $N_2(X\ ^1\Sigma_g^+)$. This critical study is based on a hierarchy of Hartree-Fock-Roothaan wave functions which differ in the size and composition of the expansion basis set in terms of STO symmetry orbitals. The concluding basis set gives a total Hartree-Fock energy of −108.9956 Hartrees and $R_e(HF) = 2.0132$ Bohr for $N_2(X\ ^1\Sigma_g^+)$. Results are also presented from direct calculations for three states of the N_2^+ molecular-ion ($X\ ^2\Sigma_g^+$, $A\ ^2\Pi_u$, $B\ ^2\Sigma_u^+$) which are also thought to be very close approximations to the true Hartree-Fock values. The results give $E_{HF} = -108.4079$ H., −108.4320 H., and −108.2702 H. and $R_e(HF) = 2.0385$ B., 2.134 B., and 1.934 B. for the $X\ ^2\Sigma_g$, $A\ ^2\Pi_u$, and $B\ ^2\Sigma_u^+$ states of N_2^+, respectively. Extensive calculations for various R values establishes that the $X\ ^2\Sigma_g^+$ and $A\ ^2\Pi_u$ states are reversed in order relative to experiment, a short coming ascribed to the Hartree-Fock approximation. Author

N65-32629 Chicago Univ., Ill. Lab. of Molecular Structure and Spectra.
ELECTRONIC STRUCTURE OF CO AND BF
Winifred M. Huo *In its* [Studies in Mol. Struct. and Wavefunctions] [1964] p 192–241 refs (See N65-32626 21-24)

Single determinantal self-consistent field wave functions calculated by the expansion method are reported for the ground state of CO and BF. These calculations were performed at four different internuclear distances, including the experimental equilibrium internuclear distance. Exponents are optimized at all four distances. Potential curves and dipole moment curves are obtained. From the potential curve, spectroscopic constants are calculated via the Dunham analysis. An SCF calculation was then performed at the calculated R_e. Exponents are also optimized. Expectation values of a number of one-electron operators, including the electric dipole moment, the gradient of the electric field at the nucleus and the Hellmann-Feynman force, are presented and compared with experimental data available. Contour diagrams for the total charge densities and orbital charge densities are included. Author

N65-32630 Chicago Univ., Ill. Lab. of Molecular Structure and Spectra.
HARTREE-FOCK-ROOTHAAN WAVE FUNCTIONS, POTENTIAL CURVES, AND CHARGE DENSITY CONTOURS FOR THE HeH^+ ($X^1\Sigma^+$) AND NeH^+ ($X^1\Sigma^+$) MOLECULE IONS
Sigrid Peyerimhoff *In its* [Studies in Mol. Struct. and Wavefunctions] [1964] p 242–274 refs (See N65-32626 21-24)

Hartree-Fock-Roothaan wave functions for the ground state of the HeH^+ ion and the NeH^+ ion are reported. The potential curves for HeH^+ and NeH^+ are calculated using wavefunctions, which are optimized at the equilibrium distance and also at each internuclear distance, and their relative behavior is discussed. The Hellmann-Feynman forces on the nuclei are studied as a function of the internuclear distance with regard to the size of the basis set and optimization of the wave function. Spectroscopic data are calculated in different ways, a dissociation energy of 1.74 eV for HeH^+ and 2.03 eV for NeH^+ is computed, and calculations made to find the center of negative charge for every internuclear separation. Electron density maps are plotted for several internuclear distances in HeH^+ and for the total wave function and the individual molecular orbitals of NeH^+ at the equilibrium distance. Author

N65-32631 Chicago Univ., Ill. Lab. of Molecular Structure and Spectra.
RARE-GAS AND HYDROGEN MOLECULE ELECTRONIC STATES, NONCROSSING RULE, AND RECOMBINATION OF ELECTRONS WITH RAW-GAS AND HYDROGEN IONS
Robert S. Mulliken *In its* [Studies in Mol. Struct. and Wavefunctions] [1964] p 275–278 refs Repr. from Phys. Rev., v. 136, no. 4A, 16 Nov. 1964 p A962–A965 (See N65-32626 21-24)

Recent experimental work on helium jets has indicated that excited atoms result usually from collisional-radiative electron capture by atom ions ($A^+ + 2e \rightarrow A^* + e$; etc.) rather than by dissociative recombination by molecule ions ($A_2^+ + e \rightarrow A^* + A$), while for the heavier rare gases, the latter process is apparently relatively important. It is shown in the present paper that the theoretically expected forms of the potential curves of excited He_2 and other rare gas molecules make dissociative recombination improbable for He_2^+ but more probable for the other rare gas diatomic ions. Available spectroscopic data and theoretical considerations make it fairly sure that many of the familiar excited states of He_2 have high maxima in their potential curves, but that no pure repulsion curves, except the one for two normal He atoms, exist below the energy of $He^+ + He$. Besides the stable states with stable He_2^+ core ($1\sigma_g^2 1\sigma_u^2 {}^2\Sigma_u^+$) plus a Rydberg electron, there must be others with a core ($1\sigma_g\, 1\sigma_u^2 {}^2\Sigma_g^+$) which per se is unstable but which on addition of an electron in a sufficiently strongly bound Rydberg orbital is stable; consideration of these states makes possible a reasonable explanation of the Hornbeck–Molnar effect in helium. Statements analogous to those about potential curves and electron recombination in helium are applicable also to a large extent for hydrogen. Author

N65-32632 Chicago Univ., Ill. Lab. of Molecular Structure and Spectra.
OCTOPOLE MOMENT OF METHANE
John J. Sinai *In its* [Studies in Mol. Struct. and Wavefunctions] [1964] p 279–281 refs Repr. from J. Chem. Phys., v. 40, no. 12, Jun. 1964 p 3596–3598 (See N65-32626 21-24)
(Grant NSF GP-28)

The octopole moment of methane is calculated using three different LCAO-MO-SCF wavefunctions. The numerical method of calculation is illustrated. Results are compared with the experimental value of James and Keenan, as well as the theoretically computed value of Turner *et al* who used the one-center-expansion-method wavefunction of Saturno and Parr. A brief discussion of these different wavefunctions and the octopole moments obtained from them is given. Author

N65-32636 Chicago Univ., Ill. Lab. of Molecular Structure and Spectra.
ROTATION-ELECTRONIC INTERACTION IN THE RYDBERG STATES OF DIATOMIC MOLECULES
Ying-Nan Chiu *In its* [Studies in Mol. Struct. and Wavefunctions] [1964] p 306–320 refs Repr. from J. Chem. Phys., v. 41, no. 10, 15 Nov. 1964 p 3235–3249 Presented at Symp. on Mol. Struct. and Spectry., Columbus, Ohio, Jun. 1964 (See N65-32626 21-24)
(Grant NSF GP-28)

The theoretical foundation of Hund's coupling cases for the interaction between rotation and electronic motion is reexamined. The relationship between different cases is shown by angular-momentum coupling techniques. Rotational interaction terms neglected in the Born–Oppenheimer adiabatic type approximation and in the idealized Hund's cases are considered in particular. For application to Rydberg states, new and improved perturbed energy expressions of Λ doubling for spectroscopic use are derived up to the fourth order for a near Hund's Case *b'* diatomic molecule and up to the second order for a near Hund's Case *d'* diatomic molecule. Specific formulas are given for the *p*-term ($L = 1$) and the *d*-term ($L = 2$) complexes. For the approach towards cases intermediate between *b'* and *d'*, secular determinants for this perturbation problem are formulated starting both from ideal case *b'* and from ideal case *d'* using two parameters, instead of one, for the *d*-term complex. These two approaches are shown to give equivalent results proving the consistency of the perturbations and assumptions used at both ends. The nature of these assumptions as well as the physical basis for the transition between Case *b'* and Case *d'* are shown. Author

N65-32637 Chicago Univ., Ill. Lab. of Molecular Structure and Spectra.
ELECTRIC QUADRUPOLE AND MAGNETIC DIPOLE RADIATION IN LINEAR MOLECULES. APPLICATIONS TO $^1\Phi$–$^3\Phi$ TRANSITIONS

Ying-Nan Chiu *In its* [Studies in Mol. Struct. and Wavefunctions] [1964] p 321–343 refs (See N65-32626 21-24)
(Grant NSF GP-28)

The electric quadrupole and magnetic dipole operators of a rotating, linear molecule interacting with a radiation field are formulated, in the space-fixed and in the molecular coordinate systems, as contractions of irreducible spherical tensors. Radiative transition probabilities are obtained for the initial and final rotation-electronic states that are in Hund's coupling case a or b, using the normalized rotation matrix as the separated rotational wavefunction in the Born-Oppenheimer approximation. Line strength formulas are derived for (1) transitions between singlet case b states, in the case of an electric quadrupole, the $^1\Sigma$–$^1\Sigma$, $^1\Pi$–$^1\Sigma$, $^1\Delta$–$^1\Sigma$, $^1\Pi$–$^1\Pi$, $^1\Delta$–$^1\Pi$, $^1\Phi$–$^1\Pi$, $^1\Delta$–$^1\Delta$, $^1\Phi$–$^1\Delta$, and $^1\Gamma$–$^1\Delta$ transitions; in the case of a magnetic dipole, the $^1\Pi$–$^1\Phi$, $^1\Pi$–$^1\Pi$, $^1\Delta$–$^1\Pi$, $^1\Delta$–$^1\Delta$ and $^1\Phi$–$^1\Delta$ transitions (2) the $^1\Pi$–^{3}(a) transitions (3) the $^1\Pi$–$^3\Pi$(b) transitions. The master line strength formula as well as intensity distribution for different branches are given. In (2) and (3), some of the transitions are found to be dependent on the absolute Krönig reflection symmetry, giving, for molecules of unequal nuclei, an intensity alternation for the two Λ-doubling components.

N65-32638 Chicago Univ., Ill. Lab. of Molecular Structure and Spectra.
ON THE INTENSITY OF ELECTRIC DIPOLE TRANSITIONS
Ying-Nan Chiu *In its* [Studies in Mol. Struct. and Wavefunctions] [1964] p 344–348 refs (See N65-32626 21-24)
(Grant NSF GP-28)

A new method is proposed to derive the electric dipole transition intensity distributions for the electronic bands of diatomic molecules. The theoretical foundation of the use of the Hönl-London intensity formula and its shortcomings are discussed. Author

N65-32639 Chicago Univ., Ill. Lab. of Molecular Structure and Spectra.
ON THE VECTOR ADDITION THEOREM FOR THE EXPANSION OF SOLID SPHERICAL HARMONICS
Ying-nan Chiu *In its* [Studies in Mol. Struct. and Wavefunctions] [1964] p 349–351 refs (See N65-32626 21-24)
(Grant NSF GP-28)

Expansion of solid spherical harmonics $r_b^n\ Y_n^k(\theta_b,\phi_b)$ or $r_b^{-n-1}\ Y_n^k(\theta_b,\phi_b)$ of vector r_b referred to center b in terms of those on another center, as well as the expansion of solid spherical harmonics of the interelectronic vector r_{12} in terms of those of individual electron position vectors r_1 and r_2 are useful in the evaluation of molecular integrals that occur in the study of electric and magnetic interaction in molecules. In a recent paper, Chiu demonstrated the common principle behind the above kinds of expansions and showed the vector addition nature of solid spherical harmonics expansions through expressing them as coupling of irreducible spherical tensors. From this principle we shall reformulate in a clearer way and shall give a thumb rule for its ready application to physical problems. By use of this theorem one can easily write down any expansion of solid spherical harmonics, including those in existing literature. Author

N65-32640 National Univ. of Ireland, Dublin. Dept. of Physics.
ISOTOPE SHIFTS AND THE VIBRATIONAL STRUCTURE IN SOME WEAKER SYSTEMS OF N_2
D. Mahon-Smith and P. K. Carroll (Chicago Univ.) *In* Chicago Univ. [Studies in Mol. Struct. and Wavefunctions] [1964] p 352–357 refs Repr. from J. Chem. Phys., v. 41, no. 5, 1 Sep. 1964 p 1377–1382 (See N65-32626 21-24)

The emission spectrum of $^{15}N_2$ has been studied in the region 2000–9000 Å with a view to investigating the vibrational structure of some of the weaker systems. In the cases of the Herman infrared bands and the Gaydon–Herman green bands, it has been possible to decide between alternative vibrational schemes which have been suggested. Observations have also been made on the Goldstein–Kaplan and the $B' \rightarrow B$ systems. In the near-ultraviolet spectrum it is shown that the $h \rightarrow a$, $s' \rightarrow a$, $r' \rightarrow a$, $m \rightarrow a$, and $d \rightarrow a$ progression all arise from upper levels with $v > 0$. The possibility that some of these progressions may belong to a single system is discussed. The vibrational schemes for the fifth positive and Kaplan's first and second systems have been confirmed. Some new bands of $^{15}N_2$ corresponding apparently to hitherto unobserved transitions are reported. Author

N65-32641 Chicago Univ., Ill. Lab. of Molecular Structure and Spectra.
SPECTRUM AND STRUCTURE OF THE He_2 MOLECULE. I: CHARACTERIZATION OF THE STATES ASSOCIATED WITH THE UAO'S 3pσ AND 2s
Marshall L. Ginter *In its* [Studies in Mol. Struct. and Wavefunctions] [1964] p 358–365 refs Repr. from J. Chem. Phys., v. 42, no. 2, 15 Jan. 1965 p 561–568 (See N65-32626 21-24)
(Grant NSF GP-28)

The He_2 band systems 3pσ, $^{1,3}\Sigma_g^+ \rightarrow 2s$, $^{1,3}\Sigma_u^+$ are described in detail. The rotational and vibrational constants of the 2s, a $^3\Sigma_u^+$, and A $^1\Sigma_u^+$ and 3pσ, c $^3\Sigma_g^+$ states are improved and the data for the A and c states extended from v = 1 to v = 3 and 4, respectively. The 3pσ C $^1\Sigma_g^+$ state (identified for the first time) has been characterized through v = 5. The apparent dissociation energy of the c $^3\Sigma_g^+$ state is found to be ~ 0.7 eV too high to be consistent with the theoretical dissociation energy of He_2^+. If the D_o value for He_2^+ is correct, large maxima must be present in the potential curves of a number of electronic states of He_2. Also discussed is the observed and expected behavior of states associated with npσ UAO's. Author

N65-32686# RAND Corp., Santa Monica, Calif.
ENERGY-DEPENDENT NEUTRON TRANSPORT THEORY IN PLANE GEOMETRY. III: HALF-RANGE COMPLETENESS AND HALF-SPACE PROBLEMS
A. Leonard and Joel H. Ferziger (Stanford Univ.) Jun. 1965 36 p refs
(P-3167; AD-617882)

A set of elementary solutions to the energy-dependent Boltzmann equation is shown to possess a half-range completeness property allowing the exact solution to energy-dependent half-space problems and the reduction of finite-slab problems to rapidly convergent Fredholm equations. Results follow the one-velocity transport equation except that a system of singular integral equations is encountered, giving rise to the Hilbert problems for matrices. Applications of the completeness proof are made to the albedo and Milne problems for a half-space. Author

N65-32687# Litton Systems, Inc., Minneapolis, Minn. Applied Science Div.
SPUTTERING Annual Report, 1 Nov. 1963–31 Oct. 1964
R. V. Stuart and G. K. Wehner Nov. 1964 53 p refs
(Contract Nonr-1589(15))
(Rept.-2656; AD-608946)

Energy distributions have been determined for atoms sputtered from polycrystalline targets for twenty-three different target materials. Ejection energies are found to depend strongly

on the mass of the target atom. Most probable and average ejection energies plotted as a function of the atomic number of the target material show a periodicity in that within each period these energies tend to decrease with increased filling of the d-shell. Average ejection energies range from 6.8 eV for Be to 45 eV for U. Average ejection velocities group mostly around 6×10^5 cm/sec and range from a high of 11×10^5 cm/sec for Be to a low of 3.9×10^5 cm/sec for Ag. Author

N65-32721*# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
CALCULATION OF HYDROGEN ATOM CROSS SECTIONS Final Report
Frank R. Pomilla and S. N. Milford May 1965 82 p refs
(Contract NASw-894)
(NASA-CR-64455; RE-210) CFSTI: HC $3.00/MF $0.75 CSCL 20H

Born cross sections for double inelastic collisions between two hydrogen atoms are calculated. The case in which one of the atoms is initially in the ground state and the case in which both atoms are initially in excited states are studied for center of mass energies in the range 2keV to 100 MeV. The hydrogen atom–hydrogen atom Born differential cross section is formulated in terms of the electron–hydrogen atom Born differential cross sections for each of the colliding atoms. This formulation was chosen so that an existing IBM 7094 computer program for the evaluation of the electron–hydrogen Born differential cross sections could be used to calculate the hydrogen atom–hydrogen atom Born differential cross sections. The hydrogen atom–hydrogen atom total cross sections are calculated by numerical integration of the differential cross sections. The numerical results of the computer calculations are shown and discussed. R.N.A.

N65-32740# Harvard Univ., Cambridge, Mass. Cruft Lab.
PHONON ANHARMONICITY AND MICROWAVE ABSORPTION IN ALKALI HALIDE CRYSTALS
James C. Owens 17 Nov. 1964 268 p refs
(Contract Nonr-1866(16))
(TR-459; AD-610689)

A general study of the absorption of far infrared and microwave radiation by alkali halide crystals having the NaCl structure was carried out. The existing theories of the interaction of electromagnetic radiation with anharmonic three-dimensional ionic crystal lattices are critically reviewed and serious shortcomings pointed out. A more complete quantum-mechanical perturbation theory of absorption by such crystal lattices is proposed, using the formalism of second quantization and the technique of diagrammatic evaluation of matrix elements. Measurements of the dielectric constant and loss tangent of LiF, NaCl, and KBr were made at frequencies of 9.8, 35.4, and 116 kMc between 25 and 750C., with some additional measurements at temperatures as low as −190C. The results of these measurements definitely establish the inadequacy of previous theories of absorption by ionic crystals, both classical and quantum-mechanical, in which only the lowest order anharmonic terms in the potential energy are considered, and corroborate the general features of the new theory. Author

N65-32749# RAND Corp., Santa Monica, Calif.
ENERGY-DEPENDENT NEUTRON TRANSPORT THEORY IN PLANE GEOMETRY. II: EIGENFUNCTIONS AND FULL-RANGE COMPLETENESS
A. Leonard and Joel H. Ferziger Jun. 1965 41 p refs
(P-3166; AD-617880)

Our earlier treatment of the energy-dependent transport equation (1) is extended to include the case in which cross sections are functions of energy. The technique again consists of finding solutions to the homogeneous transport equation after expanding in terms of a complete set of functions in the energy variable. Unlike the problem treated in (1), the full-range completeness theorem for these eigenfunctions requires the solution of a coupled set of singular integral equations. This solution is effected by a generalization of a trick used by Case (2) and is applied to the problem for the infinite medium Green's function. Numerical results are given for a heavy gas model. The half-range completeness theorem, which may be applied to half-space and finite slab problems, it proven in a companion paper. Author

N65-32768# Stanford Univ., Calif. Linear Accelerator Center.
SPIN AND PARITY ANALYSIS IN TWO-STEP DECAY PROCESSES
S. M. Berman and M. Jocob May 1965 38 p refs
(Contract AT(04-3)-515)
(SLAC-43)

Results are given for applying the helicity formalism to spin and parity analysis of a certain class of resonances decaying into another resonance and a non-resonant particle with the subsequent decay of the intermediate resonance into non-resonant particles. Integer and half integer cases are treated separately. The method outlined herein is hoped to be useful to those experimenters interested in performing a spin and parity analysis on resonance decay data. Author

N65-32774# Chicago Univ., Ill. Lab. of Molecular Structure and Spectra.
[ATOMIC AND MOLECULAR STRUCTURE INVESTIGATIONS] Quarterly Status Report, 1 Apr.–30 Jun. 1965
Clemens C. J. Roothaan [1965] 9 p
(Contract DA-11-022-ORD-3119; ARPA Order 368)
(QSR-24; AD-618712)

Work from April through June 1965 consisted of: rewriting of the subroutines for the total self-consistent field wave function (SCF) program; studies of the atomic dipole polarization in iso-electronic two- and four-electron systems; the completion of SCF calculations on a number of low lying states of Cu and Cu^+; completion of studies on ground configuration states and ions of the first row homonuclear diatomic molecules, A_2; calculations on the ground configuration state of diatomic hydride molecules, AH; SCF calculations of molecules with C_{2v} symmetry; and wave function calculations for the H_2, Li_2, and F_2 systems. G.G.

N65-32779# California Univ., Berkeley. Lawrence Radiation Lab.
BEVATRON OPERATIONS AND DEVELOPMENT, 45, JANUARY THROUGH MARCH 1965
Kenneth C. Crebbin 23 Jun. 1965 14 p ref
(Contract W-7405-ENG-48)
(UCRL-16204) CFSTI: $1.00

The Bevatron provided beam for physics research for 81% of the scheduled operating time. We achieved a much more stable operation than formerly by using (1) a modified inflector-tuning procedure and (2) an inner radius cup with which beam injected into the Bevatron was measured. A major shutdown this quarter allowed inspection of bearings and journals on the main motor generator sets. Four primary experiments ended this quarter and one new primary experiment started. Author

N65-32780# Brookhaven National Lab., Upton, N. Y.
THE FAST BEAM EXTRACTION SYSTEM OF THE ALTERNATING GRADIENT SYNCHROTRON
E. B. Forsyth and C. Lasky 10 Mar. 1965 28 p
(BNL-910(T-373)) CFSTI: $2.00

The system provides a fast, single-turn, extracted beam from the Alternating Gradient Synchrotron (AGS) at machine energies from 10 to 32 BeV with essentially 100% efficiency. Three pulsed magnets coupled to the beam by coherent betatron oscillations are the major components of the system. Two of the magnets are constructed in the form of a septum, the septum plate dividing areas of high magnetic field from areas of almost zero field. Before ejection normal acceleration occurs in the AGS as the beam lies on the zero field side of the septa. The beam is ejected when the third magnet is pulsed. Thus, if the pulsed field is properly synchronized to bunch position, protons are deflected into the high field areas of the septum magnets and out of the AGS. Author

N65-32787# Princeton Univ., N. J. Plasma Physics Lab.
A REMARK ON ION ELECTRON RECOMBINATION
Nicola D'Angelo Aug. 1965 6 p refs
(Contract AT(30-1)-1238)
(MATT-360)

A simple extension of Thomson's formula was used to find the recombination coefficient α for the three-body process of the ion-electron recombination occurring by collisions of two electrons in the field of an ion. It was assumed that if either ion, while within a certain distance from the other, loses energy by collision with a neutral atom, recombination occurs. The collision mean free paths of ion 1 and ion 2 with the neutral atoms were considered in a recombination cross section, and applied to the process $H^+ + e^- + e^- \rightarrow H + e^-$. This leads to the formula

$$\alpha = \frac{4}{3}\pi r_0^2 v_{eth} r_0 / \lambda_{e-e},$$

where v_{eth} is the electron thermal velocity and λ_{e-e} the electron collision mean free path for the energy exchange. The value of α was found to be 7.7×10^{-27}. G.G.

N65-32813# International Centre for Theorehcal Physics, Trieste (Italy).
PROTON-NEUTRON MAGNETIC MOMENT RATIO IN WIGNER'S THEORY OF SUPERMULTIPLET
Y. C. Leung and A. O. Barut 6 Feb. 1965 6 p refs
(IC-65-16)

A proposal for a reexamination of Wigner's theory of supermultiplets, (denoted by its symmetry group SU_4 in view of results from considerations of the symmetry group SU_6) is made. An attempt is made to show that the correct prediction of the ratio of the proton to neutron magnetic moment by the SU_6 theory can already be obtained from the SU_4 theory, where the symmetry group SU_4 is a subgroup of SU_6, and contains the spin and isospin groups in the form of a direct product. The only difference between the new approach and Wigner's approach is in the assignment of the particles to different irreducible representations of SU_4. In analogy to the quark model of SU_6, where $6 \times 6 \times 6 = 56 + 20 + 70 + 70$ and the baryons are assigned to the 56-dimensional representation, $4 \times 4 \times 4 = 20 + 4 + 20 + 20$ is written for SU_4 and the nucleons are assigned to the 20-dimensional representation. This particular 20-dimensional representation of SU_4 has exactly the same symmetry properties as the 56-dimensional representation of SU_6. In Wigner's theory, the nucleons are assigned to the 4-dimensional representation thus accounting for the difference in the two approaches. Calculations are shown leading to the ratio of the proton to neutron magnetic moments. L.S.

N65-32814# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
SOME CONSIDERATIONS OF THE ENERGY SPECTRUM OF ODD-ODD DEFORMED NUCLEI [QUELQUES CONSIDERATIONS SUR LE SPECTRE D'ENERGIE DES NOYAUX IMPAIR-IMPAIR DEFORMES]
Alceanu-G. De Pinho and Jean Picard Feb. 1965 25 p refs In FRENCH
(CEA-R-2730) CFSTI: HC $1.00/MF $0.50

The residual interaction between two unpaired nucleons within odd-odd deformed nuclei is considered. The Hamiltonian equation is given for the problem, and calculations are provided which describe the interaction between the nucleons as they move in their independent orbits, Q_p and Q_n. Tabulated results show that the residual proton–neutron interaction within odd-odd deformed nuclei can be expressed by an extremely simple actual force. Transl. by G.A.L.

N65-32815# International Centre for Theoretical Physics, Trieste (Italy).
ON A SYMMETRY SCHEME DESCRIBED BY A NON-LIE ALGEBRA
J. Werle Apr. 1965 10 p refs Submitted for Publication
(IC-65-48)

The possibility of using a non-Lie algebra A in symmetry considerations is discussed. The algebra A contains the Lie algebras of the Poincare group P and of the intrinsic symmetry group S. It is shown on a simple example that by imposing suitable commutation relations between the generators of P and S one can obtain a discrete mass formula without breaking the intrinsic symmetry S used for the classification of particles. A non-Lie algebra of the considered type can describe well all the self-interactions of particles but cannot be required as a rigorous symmetry in the case of two or more interacting particles (reactions). Author

N65-32828# Oak Ridge National Lab., Tenn.
"EXPLOSION" OF MULTICHARGED MOLECULAR IONS: CHEMICAL CONSEQUENCES OF INNER SHELL VACANCIES
Thomas A. Carlson and R. Milford White [1964] 13 p refs
(Contract W-7405-ENG-26)
(ORNL-P-591; CONF-773-1)

A description is then given of a new charge spectrometer, which utilizes X-rays to initiate inner shell vacancies. With this spectrometer it is possible to measure the relative abundances of all the fragment ions formed in the decomposition of the parent molecule without the errors that arose earlier from a dependence of collection efficiency on recoil energy. Furthermore, it has been possible to measure the recoil spectrum for each of the ions. As an example, some recently acquired data are given on the decomposition of CH_3I following vacancies formed primarily in the L shell of iodine by X-rays. The decomposition is violent, with the molecule decomposing almost entirely into H^+, C^{n+}, and I^{n+}. The relative abundance of molecular ions is very small. The sums of the carbon, iodine, and hydrogen ions are in the approximate ratios of 1:1:3 suggesting that the quantity of neutral species is also small. The most abundant carbon ion is C^{2+}, which possesses an average recoil energy of about 40 eV. The most abundant iodine species is I^{6+}, which contrasts with an average

charge of eight from an analysis of Xe ions produced with X-rays of the same energy. These and other data on the recoil and charge spectra from CH^3I are compared with the calculations using a model of a multiple-ion Coulomb "explosion." Author

N65-32840# Brookhaven National Lab., Upton, N. Y.
OPERATING ENERGIES AND FLUXES FOR THE RF SEPARATED BEAM
H. Foelsche and J. Sandweiss (Yale Univ.) 20 Oct. 1964 8 p refs
(Contract AT(30-2)-GEN-16)
(BNL-8556)

Operating moments and meson yields for various modes of operation are tabulated for a radio frequency separated beam which was designed for an eighty-inch chamber. Also, preliminary results from a flux analysis, which involved Monte Carlo investigation of the effects of slit scattering and pion decay in flight, indicate that good separations can be achieved. J.M.D.

N65-32845# Argonne National Lab., Ill.
MONTE CARLO CALCULATION OF THE ENERGY LOSS SPECTRA FOR GAMMA RAYS IN SODIUM IODIDE AND CESIUM IODIDE
W. F. Miller and William J. Snow Feb. 1961 85 p refs
(Contract W-31-109-ENG-38)
(ANL-6318) CFSTI: $2.00

The energy loss spectra for gamma rays in NaI and CsI crystals have been calculated by the Monte Carlo method. The calculations have been carried out for point sources, broad and collimated parallel beams, and disc sources of mono-energetic gamma rays varying in energy from 0.142 to 14.0 Mev. The crystals considered were right circular cylinders, varying from small crystals of height and diameter of 0.5 inch to large crystals of height 12 inches and diameter 9 inches, and in addition for a sphere of 1-inch radius. Also calculated simultaneously with the energy loss spectra were the efficiencies and total absorption fractions. Author

N65-32847# Brookhaven National Lab., Upton, N. Y.
A STUDY OF GENERALIZED LEVEL DENSITY BY THE METHODS OF DIFFERENTIAL-RECURRENCE EQUATIONS
Peter B. Kahn and Charles E. Porter Jul. 1965 28 p refs
(BNL-934(T-386)) CFSTI: $2.00

Level density formulae are derived for certain unitary generalized ensembles. The results are in agreement with those derived by other methods of approximation. Author

N65-32898# Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.
THEORETICAL ANALYSIS OF THE ABSORPTION SPECTRA OF A SIMPLE VIBRATING ATOM
E. E. Klingman, III Sep. 1965 60 p refs
(R-154)

A fully second-quantized Hamiltonian is applied in a Green's function calculation to determine effects of nuclear motion on the absorption spectrum of a simplified model F-center. The coefficients appearing in terms describing the energy shifts are calculated and a Univac 1107 FORTRAN program is used to compute the energy shifts in the absorption spectrum. The physical interpretation of the results leads to the conclusion that the Coulter Hamiltonian is well suited to such applications. Author

N65-32909# Hazelton-Nuclear Science Corp., Palo Alto, Calif.
A PROCEDURE FOR THE CALCULATION OF NEUTRON ACTIVATION OF AN INFINITE HOMOGENEOUS MEDIUM
C. L. Carnahan 15 Sep. 1964 40 p refs
(HNS-1229-54)

A method for the calculation of quantities of radionuclides induced in infinite, homogeneous media by neutrons from underground nuclear detonations is developed theoretically and a procedure for practical application of the theory is presented. Results of calculations are given for radionuclides, having half lives greater than 0.5 year, induced by neutrons from fusion reactions and from fission reactions in media having the compositions of the average earth's crust, average carbonate rocks, and the Tatum salt dome, Hattiesburg, Mississippi. Separate calculations are made for fusion neutrons and for fission neutrons because of the great differences in the initial neutron energy distributions and in the total numbers of neutrons produced, per unit energy yield, by the two processes. The following types of reactions are treated: (n,γ), (n,p), (n,α), (n,2n), and (n,np). Secondary reactions and second-order reactions are not considered. Effects due to activation of device and emplacement materials are not considered, and effects due to special neutron-moderating and absorbing materials placed around the device are considered only very superficially. A sample calculation is included in the Appendix. Author

N65-32910# Tokyo Univ. (Japan). Inst. for Nuclear Study.
A SIMPLE METHOD FOR EVALUATIONS OF THE ABERRATIONS DUE TO QUADRUPOLE-MAGNET SYSTEMS
Kohsuke Yagi 22 Aug. 1964 33 p refs
(INST-78) CFSTI: HC $2.00/MF $0.50

The third-order aberations due to a quadrupole magnet and to a quadrupole-magnet doublet are formulated. First, trajectory equations for charged particles in a quadrupole magnet are derived to third order. The third-order terms arise from the following two sources: the variation of the longitudinal velocity as a result of the slope of the trajectory, and the existence of the longitudinal component of the magnetic field. The nonlinear trajectory equations are solved by the successive approximation. The solutions are then expressed by simple analytic functions to third order. The edge effect of the quadrupole magnet is taken into account by the use of the step function. By applying these solutions to a quadrupole magnet and to a quadrupole-magnet doublet, the formulas for the third-order aberrations are obtained. They are expressed by simple analytic functions of the parameters of the boundary conditions and the quadrupole-magnet system. Author

N65-32916# Oak Ridge National Lab., Tenn.
DISSOCIATION OF H_2^+ IONS IN ATOMIC AND MOLECULAR GAS COLLISIONS
R. N. Il'in, B. I. Kikikiani, V. A. Oparin, E. S. Solov'ev, and N. V. Fedorenko 19 Oct. 1964 7 p refs Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow), v. 46, Apr. 1964 p 1205–1211
(ORNL-TR-319)

Cross sections of protons in the dissociation of molecular H_2^+ were measured in hydrogen, nitrogen, helium, and argon over a broad energy region. In an attempt to eliminate the basic sources of errors in measuring cross sections, the gas pressure in the collision chamber was sufficiently low to observe single-stage collision conditions and the effective gas thickness was determined by pressure drop at the collision chamber aperture. Simultaneous measurement was made of the beam of protons formed during dissociation and the beam of hydrogen

ions. In an effort to improve geometric experimental conditions, optimum dimensions of the aperture and receiver were selected. It is hypothesized that cross sections under 30 kev are deflated and random measurement errors are about ±12%. Illustrations of the cross sections are included. M.W.R.

N65-32918# California Univ., Livermore. Lawrence Radiation Lab.
CONTRIBUTIONS TO THE STUDY OF INFRARED EMISSIONS IN GERMANIUM
Jacques I. Pankove Aug. 1964 40 p refs Transl. into ENGLISH from Ann. Phys. (Paris), v. 6, 1961 p 331–374
(UCRL-TRANS-1111(L))

Infrared emission due to radiative transitions of holes between two branches of the valence bond of germanium was studied and the optical properties of very impure germanium examined. By comparing its properties with that of a purely thermal emission (without injection of holes), it was proven that this emission is not thermal. The emissive spectrum consisted of a large band having a sharp peak at 6.6 ±0.1μ. A new parasite effect was discovered which can be used to measure the absorption by minority carriers. Absorption measurements as well as emission measurements showed that the forbidden band of the very impure germanium can be reduced by the impurities. The reduction of the forbidden band was confirmed by calculations based on electrical measurements on tunnel diodes. It was also found that the germanium-tin alloy has an absorption limit at about 0.2eV which could represent the width of the forbidden band of a new semi-conductor. Also discovered were several new modes of infrared luminescence in germanium. S.C.W.

N65-32919# Virginia Polytechnic Inst., Blacksburg, Va.
CHEMICAL EFFECTS OF THE NUCLEAR REACTION $N^{14}(n,p)C^{14}$ IN VARIOUS IRRADIATED NITROGENOUS COMPOUNDS Final Report
John D. Vaughan [1964] 26 p refs
(Contract AT(40-1)-2726)
(TID-21121)

An investigation is presented to study the hot-atom chemistry of carbon in liquid hydrazine and in hydrazinium salts; to establish definitively the origin of oxygen in oxygen containing irradiated targets that contain no lattice oxygen; and to interpret the results obtained in the hydrazine system in terms of a solid state model. The distribution of carbon-14 among various fractions in aqueous solutions of the crystalline hydrazine dihydrochloride target and the breakdown of the fractions into individual labeled one-carbon compounds are given in tabular form. It is shown that the labeled compound distribution of the $N_2H_6Cl_2$ is similar to that of the $N_2H_6Cl_2$ target. The results of hydrazine dissolution of $N_2H_6Cl_2$ suggest that moisture present during irradiation leads to the unexpected high percentage of oxygen containing labeled one-carbon compounds. In this light, it seems that water impurity in the target is a more effective scavenger for the recoil atom than lattice oxygen. C.T.C.

N65-32936# California Univ., San Diego. Dept. of Chemistry.
PROJECTION OPERATORS FOR ATOMIC AND MOLECULAR PROBLEMS
George S. Handler [1964] 16 p refs Sponsored by ARPA
(AROD-5133-5; AD-464890)

An operator formalism is developed that allows full account of correlation to be taken in terms of a wave function with all interparticle coordinates. The operator is shown to be an eigenoperator of S^2. Author

N65-32948# California Univ., La Jolla. Inst. for Radiation Physics and Aerodynamics.
WAVE FUNCTIONS AND TRANSITION PROBABILITIES IN SCALED THOMAS-FERMI ION POTENTIALS
Manuel Rotenberg and John C. Stewart (Gen. Dyn. Corp.) 24 Mar. 1965 27 p refs
(Contract DA-31-124-ARO(D)-257)
(AROD-5133-11; AD-464999)

A semi-empirical method for computing atomic and ionic wave functions is proposed. The method uses a one-electron potential obtained from a scaled Thomas-Fermi ionic charge distribution. The scale factors are chosen to make the one-electron binding energies agree with experimental ionization potentials. A number of oscillator strengths have been evaluated and are found to agree well with alternative methods of calculation. The method has a wider range of applicability than that of Bates and Damgaard, and calculations are much shorter than those using the self-consistent field methods. Author

N65-32976# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
DETERMINATION OF THE CROSS-SECTIONS OF SOME NUCLEAR REACTIONS OCCURRING AS A RESULT OF COSMIC RADIATION [DETERMINATION DES SECTIONS EFFICACES DE QUELQUES REACTIONS NUCLEAIRES INTERVENANT DANS LES EFFETS DU RAYONNEMENT COSMIQUE]
Murry Allen Tamers (Ph.D. Thesis, Paris Univ.) 1963 56 p refs In FRENCH; ENGLISH summary
(CEA-2298) CFSTI: HC $3.00/MF $0.50

The high energy reactions studied during this research are reactions liable to occur as a result of cosmic radiation. On the one hand the reaction $^{16}O(p, 3p)^{14}C$ was studied and its cross-section measured between 65 MeV and 2.7 GeV; a value of 2.3 mb ±0.5 was found. These values have made it possible to forecast measurable quantities of carbon-14 in meteorites and also to measure them. On the other hand the reactions $^{12}C(^{16}O...)$, $^{12}C(^{14}N...)$ and $^{12}C(^{12}C...)$ have been studied and an attempt has been made to explain the mechanism of these reactions. Author

N65-32988# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
STUDY AND COMPARISON OF SOME METHODS FOR CALCULATING THE TRANSMISSION FACTOR OF A POTENTIAL BARRIER IN QUANTUM MECHANICS [ETUDE ET COMPARISON DE QUELQUES METHODES DE CALCUL DU FACTEUR DE TRANSMISSION D'UNE BARRIERE DE POTENTIEL EN MECANIQUE QUANTIQUE]
Pierre Jamet Apr. 1964 46 p refs In FRENCH; ENGLISH summary
(CEA-R-2400) CFSTI: HC $2.00/MF $0.50

The author formulates two accurate methods for the calculation of the transmission coefficient of a one-dimensional potential barrier. The principles of these methods are expressed in a symmetrical form with respect to the two sides of the potential barrier; this constitutes a proof of the fact that the transmission coefficient is path direction independent. The numerical application is carried out on several examples and the results are compared to those provided by the WKB method. Author

N65-33123# Oak Ridge National Lab., Tenn.
ELASTIC SCATTERING OF 12.0- AND 14.0-MeV DEUTERONS FROM ^{90}Zr AND THE REACTION $^{90}Zr(d,p)^{91}Zr$: TABULATED DIFFERENTIAL CROSS SECTIONS

J. K. Dickens, F. G. Perey, and R. J. Silva Sep. 1965 24 p ref
(Contract W-7405-ENG-26)
(ORNL-3850) CFSTI: $2.00

Numerical values of differential cross sections for elastic scattering of 12.0- and 14.0-MeV deuterons from ^{90}Zr are reported in tabular form. Cross sections were determined at 5° intervals between laboratory angles of 20 and 165°. Differential cross sections for proton groups from the $^{90}Zr(d,p)^{91}Zr$ reaction are reported: for E_d = 12.0 MeV, data are tabulated for 11 proton groups (Q = 4.981, 3.77, 3.55, 3.09, 2.91, 2.79, 2.42, 1.93, 1.73, 1.53, and 1.33 MeV), and for E_d = 14.0 MeV, data are tabulated for 9 proton groups (Q = 4.981, 3.77, 2.91, 2.79, 2.42, 1.93, 1.73, 1.53, and 1.33 MeV). Author

N65-33159# International Centre for Theoretical Physics, Trieste (Italy).
ON SOME APPLICATIONS OF SU_3 Lecture Notes
J. Werle Mar. 1965 24 p refs
(IC/65/21) CFSTI: HC $1.00/MF $0.50

Physical applications of the group SU_3 are presented, formulas of interest are derived, and the physical assumptions and approximations necessary for these derivations are given. Baryons and baryonic resonances, meson multiplets, meson-nucleon interactions, proton-proton reactions, and other fast reactions are among the applications considered. E.E.B.

N65-33171# California Univ., Berkeley. Lawrence Radiation Lab.
PHYSICS DIVISION SEMIANNUAL REPORT, MAY–OCTOBER 1964
Luis W. Alvarez et al 16 Nov. 1964 75 p refs
(Contract W-7405-ENG-48)
(UCRL-11776) CFSTI: $3.00

Research projects were conducted in the area of physics. Some of the topics that were studied are: bubble chambers, strange particle research, instrumentation, theory of the scattering matrix, particle physics, physics of the nucleus, accelerator design study, spark chambers, biology and medical physics, electronics engineering, production of nucleon isobars by 7.1-BeV/c protons, proton–proton elastic scattering, experiment on the charge-exchange interactions in elastic pion–proton scattering, and K^+p and K^+d experiment at 860 to 1600 MeV/c in the 25-inch hydrogen–deuterium bubble chamber. R.W.H.

N65-33192*# Haverford College, Pa. Strawbridge Observatory.
OSCILLATOR STRENGTHS FOR SINGLET AND TRIPLET SERIES IN NEUTRAL HELIUM
Louis C. Green, Norma C. Johnson, and Eleanor K. Kolchin [1965] 19 p refs
(Grant NsG-287; Contracts Nonr-1727(00); AT(30-1)-2934)
(NASA-CR-64783) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Oscillator strengths have been computed for all possible electric dipole transitions between the terms n^1s, n^3s, n^1p, n^3p, n^1d, where n goes from one to nine for S term = two to eight for P terms, and three to eight for d terms. The computations were carried through using central field wave functions with exchange and configuration interaction. The parameters in these wave functions have previously been determined by the use of the minimum principle. The oscillator strengths as computed by the length and velocity expressions are reported. For the 1^1s–n^1p series, the results found with the acceleration expression are also included. The agreement between the results obtained with the length and the velocity expressions as well as that between the present work and earlier computations, where available, give confidence in the dependability of the results. Author

N65-33211# Atomic Energy Commission Research Establishment, Riso (Denmark).
A LOW-TEMPERATURE TECHNIQUE FOR MEASUREMENT OF HEAVY-PARTICLE STOPPING POWERS OF METALS
Hans Henrik Andersen Jan. 1965 61 p refs
(RISO-93; AD-464935)

A new method for measuring ionization stopping powers for charged particles in metals is presented. The method utilizes a thermometric compensation technique and works at liquid-helium temperature. Corrections to the measured stopping powers are discussed in considerable detail, and correction curves are given. On the basis of the discussion of corrections and errors, the total error of the data is concluded to be 0.3%. To illustrate the technique, stopping-power data for 6-12 MeV protons and deuterons in aluminium are presented. Author

N65-33247# Brookhaven National Lab., Upton, N. Y.
APPROACH TO EQUILIBRIUM OF A NEUTRON PULSE IN GRAPHITE
Ajoy K. Ghatak and Henry C. Honeck Feb. 1964 7 p refs Presented at Am. Nucl. Soc. 10th Ann. Meeting, Philadelphia, 15–17 Jun., 1964
(Contract AT(30-2)-GEN-16)
(BNL-7823; CONF.-446-44)

It is reported that two methods were used in a number of calculations to study the approach to equilibrium of a neutron pulse in a graphite assembly. The first approach was to numerically solve an equation for neutron density as a non-separable function of velocity and time. The second approach involved the solution of an eigenvalue equation. C.T.C.

N65-33253*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
AN INTRODUCTION TO QUANTUM ELECTRODYNAMICS
Saul T. Epstein 5 May 1965 65 p
(Grant NsG-275-62)
(NASA-CR-64636; WIS-TCI-93) CFSTI: HC $3.00/MF $0.75 CSCL 20H

This series of four lectures is designed to make quantum electrodynamics appear as much like the familiar non-relativistic quantum mechanics of particles, as possible. No propagators, no Feynman diagrams, and no temporal or longitudinal photons are considered. The first lecture describes the dynamic variables which characterize the electromagnetic field, and an example is given for the application of quantum-mechanical methods to the field theory. The second lecture develops the destruction and creation operators for photons and momentum polarization and introduces interactions with charged particles. The third lecture discusses the spontaneous emission of light by a bound system and calculates the photoelectric effects in hydrogen due to one quantum. The last lecture derives the Thomson formula for the scattering of light by a charged particle. G.G.

N65-33389# Utah State Univ., Logan. Electro-Dynamics Labs.
OPTICAL EXCITATION OF OXYGEN BY 20 TO 100 KEV PROTONS Scientific Report No. 1

R. Gary Layton, Dorian J. Baker, Fon R. Brown, and John J. Merrill 1 Feb. 1965 144 p refs
(Contract AF 19(628)-251)
(AFCRL-65-194; AD-615466)

A spectroscopic study was made of the light (3000–5700A) emitted from impact of 18 to 102-kev protons with molecular oxygen at pressures from 1 to 400 milliTorr. The dominant emissions were from O^+ and O_2^+. Only a few weak O lines were observed since the major ones lie outside the spectral range measured. A single weak O^{++} line was identified, indicating that excited O^{++} was not a major product of the collisions. No O_2 spectra were detected. At lower proton energies, the H_β line was prominent, indicating capture of electrons into excited states by the incident H^+. Absolute emission cross sections were determined for all major transitions observed, and absolute excitation cross sections were calculated for several O^+ states. The brightest O^+ multiplet ($3s^4P - 3p^4D^o$) had a maximum emission cross section of 2.2×10^{-19} cm^2, which occurred at a proton energy of about 30 kev. The variation of emission intensities with target gas pressure and beam current were investigated in order to determine the occurrence of secondary excitations. Author

N65-33427# Rochester Univ., N. Y. Dept. of Physics and Astronomy.
π-MESON PRODUCTION IN p-p COLLISIONS
N. W. Reay, A. C. Melissinos, J. T. Reed, T. Yamanouchi, and L. C. L. Yuan (Brookhaven Natl. Lab.) 2 Aug. 1965 13 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-92)

The spectra of the π^+ and π^- mesons were measured at 2.4 BeV and 2.0 BeV and at laboratory angles of 0° and 17°. The pions were identified by momentum selection and velocity measurement, either with Cerenkov counters or by time-of-flight. Appropriate corrections for scattering and absorption in the detectors, empty target, muon and electron contamination, and pion decay were applied to the data. The absolute value of the cross sections was obtained by calibrating the dector in a special run in which narrow collimators were used to geometrically define the solid angle and momentum resolution. As a check the proton-proton elastic scattering peak was measured at 17° and was found to be in good agreement with previous work. The pion spectra in the laboratory is shown after application of all pertinent corrections. Also, the angular distribution for the isobar production used at each energy is given. The upper limit on the production of D^{+++} and the production of the bound and quasi-bound proton-neutron system are discussed. E.E.B.

N65-33434# Rochester Univ., N. Y. Dept. of Physics and Astronomy.
THE $K^{39}(He^3, \alpha)K^{38}$ AND THE $K^{39}(He^3, He^3)K^{39}$ REACTIONS
L. M. Blau, W. Parker Alford, D. Cline, and H. E. Gove 30 Jun. 1965 27 p refs Submitted for Publication Prepared in cooperation with Laval Univ.
(Contract AT(30-1)-875)
(UR-875-90)

Angular distributions of the $K^{39}(He^3, \alpha)K^{38}$ reaction leading to the ground state and first four excitated states of K^{38} have been measured over an angular range from 10° to 90° at incident energies of 9.00 and 11.00 MeV. The elastic scattering of He^3 from K^{39} has also been measured at 9 MeV, and an optical model analysis of the results has been made. At each energy the angular distributions leading to all five levels of K^{38} are similar in shape and are in reasonable agreement with the predictions of a zero range DW analysis. The angular distribution of α particles for the reactions leading to the ground ($J = 3^+$, $T = 0$) state and first excited (0^+, 1) state are characteristic of pure d-wave pick-up. The reactions leading to the second (1^+ 0), third (1^+ 0), and fourth (2^+ 1) excited states proceed primarily by d wave with a small admixture of s wave for the picked-up neutron. The measured spectroscopic factors are in reasonable agreement with the predictions of two theoretical models, one of which considers only $1d_{3/2}$ and $2s_{1/2}$ holes in the closed Ca^{40} core while the other also includes $1d_{5/2}$ hole configurations. Author

N65-33469# General Dynamics, Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
IONIZATION ENERGY DEPOSITION FROM 14-MeV NEUTRON BOMBARDMENT OF SILICON AND GERMANIUM
D. K. Nichols 10 Feb. 1965 7 p refs
(Contract DA-49-186-AMC-65(X))
(GA-6136; AD-619214)

Bombardment of silicon and germanium with 14-MeV neutrons creates energetic recoil atoms and light charged particles which lose some or all of their energy in ionizing collisions. An estimate of the amount of energy deposited in ionizing processes and the rate of formation of electron-hole pairs is calculated from recent experimental data. Author

N65-33480# Franklin Inst., Swarthmore, Pa. Bartol Research Foundation.
[RESONANCE FLUORESCENCE AND COSMIC RAYS] Annual Progress Report, 1964
11 Mar. 1965 25 p
(Contract Nonr-3777(00))
(AD-612192)

Continued research conducted under the nuclear physics program, and further measurements of cosmic ray intensity with an airborne meson telescope and neutron monitor, are reported. Summarized are results of resonance fluorescence studies in which the Van de Graaff accelerator was used, and theoretical investigations of the electromagnetic properties of isobaric analog states and their excitation by inelastic electron scattering. The analysis of measurements obtained with the neutron monitor aboard the Project Magnet-1 aircraft during the active portion of the solar cycle was completed, and results are being prepared for publication. Data applicable to the problem of nucleonic component propagation through the lower atmosphere are reported. Also included are calculations concerning the interactions of the nucleonic component in the atmosphere. S.C.W.

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N65-32396*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MONTE CARLO METHOD FOR THE CALCULATION OF TRANSPORT PROPERTIES IN A LOW-DENSITY IONIZED GAS
Charles M. Goldstein Washington, NASA, Sep. 1965 57 p refs
(NASA-TN-D-2959) CFSTI: HC $3.00/MF $0.50 CSCL 20I

An introduction to the general Monte Carlo method is presented, along with a discussion of its scope of application to plasma physics. This is followed with a heuristic sketch of the method. The problem of electron flow through a perfect Lorentzian gas in a parallel-plane diode is then formulated. The Monte Carlo solution is discussed in detail along with the relevant computational techniques employed. (Pertinent concepts from the theory of random variables are included in an appendix.) The effects of mean free path on current-voltage characteristics, density distribution, and potential distribution are presented for two cases—monoenergetic and thermionic emission. Results indicate that electron-neutral elastic collisions can have a significant effect on the current-voltage characteristics for electrode separations as small as one mean free path in the case of thermionic emission, and one-half mean free path in the case of monoenergetic emission. Author

N65-32425* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

CRYOGENICS RESEARCH

J. T. Harding *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 65–68 (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

The analysis of the magnetic forces and torques acting on a superconducting sphere which forms the rotor of a cryogenic gyro is described. The torque on the superconducting sphere is calculated by integrating the Maxwell stress tensor over the surface of the body. The applied and the trapped fields are expressed as expansions in sets of spherical harmonic functions. The final expression for torque is in the form of products of expansion coefficients of the applied and the trapped fields. Each term may be interpreted as an interaction between a mode of trapped flux configuration and a corresponding asymmetry in the magnetic field. Simple examples are illustrated. Each term in the expression for torque is a product of three factors: the expansion coefficient of the axially symmetric applied field; the expansion coefficient of the trapped field; and an angularly dependent function. Of particular significance is the fact that the contribution to torque due to a trapped flux component is null if the corresponding applied field component is zero. E.E.B.

N65-32440* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

LIQUID MHD POWER CONVERSION

D. Elliot, D. Cerini, R. Eddington, L. Hays, and E. Weinberg *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 142–150 ref (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

A liquid magnetohydrodynamic system is described. In this system a fluid circulates in the vapor loop and causes a liquid metal to circulate through an MHD generator in the liquid loop. The fluid leaves the radiator as condensate, flows through an electromagnetic pump to the mixer, vaporizes on contact with the liquid metal, atomizes, accelerates the liquid metal in the nozzle, separates from the liquid metal in the separator, and returns to the radiator. The liquid metal leaves the separator at high velocity, decelerates through the production of electric power in the MHD generator and leaves the generator with sufficient velocity to return through a diffuser to the reactor, where the liquid metal is reheated. Wall shear in two-phase flow; ac-generator end effects; limiting performance of ac-generators; experimental ac-generators; cesium–lithium erosion loop; and cycle analysis are discussed. E.E.B.

N65-32506# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

JOURNAL OF APPLIED MECHANICS AND TECHNICAL PHYSICS, NO. 6, NOVEMBER-DECEMBER 1963

9 Apr. 1965 337 p refs Transl. into ENGLISH of Zh. Prikl. Mekhan. i Tekhn. Fiz. (Moscow), no. 6, Nov.–Dec. 1963 p 1–192 (FTD-MT-64-66; AD-618314)

Studies of fluids and their properties are presented, concerning magnetic and electronic aspects of plasmas, propagation effects of explosive detonations, and pressure and flow about solid plates. For individual titles see N65-32507–N65-32546

N65-32507 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SPIRAL MOTION OF AN ELECTROCONDUCTIVE GAS BETWEEN COAXIAL PERMEABLE CYLINDERS IN THE PRESENCE OF A LONGITUDINAL MAGNETIC FIELD

I. B. Chekmarev and I. I. Shakhnov *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 1–6 refs (See N65-32506 21-25)

Calculations are given for solving flow characteristics of a spiraling electroconductive nonviscous gas between two coaxial porous electrodes creating a longitudinal magnetic field. It is shown that the radial component of speed determines the cutoff effect in the annular channel when the continuity of the gas-dynamic flow parameters is disturbed. L.S.

N65-32508 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CERTAIN PROBLEMS OF MOTION OF A CONDUCTING FLUID IN A FLAT CHANNEL

A. E. Yakubenko *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 7–14 refs (See N65-32506 21-25)

Problems about the flow of a conducting fluid in a flat channel are solved by the Wiener-Hopf method. The first problem considers the motion of a half-plate in a conducting fluid, between parallel planes in a transverse magnetic field. The second problem considers flow of a fluid between parallel walls, which half are dielectrics and half are ideal conductors. Author

N65-32509 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE SELF-CONSISTENT POTENTIAL OF DENSE LOW-TEMPERATURE PLASMA

B. N. Baranov and I. P. Pavlotskiy *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 15–23 refs (See N65-32506 21-25)

We consider the obtainment of the self-consistent potential of dense low-temperature plasma. The solution of the Poisson–Boltzmann equation is given additional conditions of self-consistency. It appears that an exact solution cannot be self-consistent. An approximate self-consistent solution is proposed. Author

N65-32510 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON BRAKING AND CONVERSION OF PLASMA ENERGY EXPANDED IN AN EMPTY SPACE, IN WHICH THERE IS A MAGNETIC FIELD

F. P. Rayzer *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 24–40 refs (See N65-32506 21-25)

Energy conversions for scattering of a very rarefied plasma cloud in an empty space were investigated. It was shown that in the process of braking, plasma loses a significant part of its energy. This energy, together with a certain quantity of magnetic energy earlier concentrated in the central region, is carried away by the electromagnetic field to large distances. Also considered is a microscopic picture of plasma scattering, and the mechanism of its interaction with a magnetic field. An assumption is made that with respect to an external magnetic field, a strongly rarefied plasma cloud behaves as a superconducting body. It is shown that the structure of the transition surface layer in the superconductor in the coordinate system, together with the moving surface element, corresponds to the Chapman–Ferraro model. L.S.

N65-32511 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON TURBULENT DIFFUSION OF WEAKLY-IONIZED MAGNETIZED PLASMA

G. M. Zaslavskiy, S. S. Moiseyev, and V. N. Orayevskiy *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 41–47 refs (See N65-32506 21-25)

Calculations are worked out for studying the anomalous diffusion of weakly-ionized plasma in a strong magnetic field. In most cases the increment of instability development is greater than or of the order of the frequency, thus not permitting the use of quasi-linear approximation or kinetic equations for waves in solving the calculations. In a few circumstances, the increment of instability development is much less than the frequency, thus making it possible to work out a more correct diffusion coefficient. L.S.

N65-32512 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE THEORY OF TURBULENT PLASMA IN A MAGNETIC FIELD

V. I. Karnman *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 48–59 refs (See N65-32506 21-25)

The coefficient of anomalous diffusion of electrons across a magnetic field in a steady turbulent state, (at which excitation waves are compensated by their absorption), is calculated. It is found that even at comparatively small frequencies of Coulomb collisions, the amplitude of steady-state oscillations is significantly larger than in the quasi-stationary state. The coefficient of diffusion is close to the same order of magnitude as Bohm's coefficient. L.S.

N65-32513 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DAMPING OF WEAK WAVES IN A RADIATING GAS

V. A. Prokof'yev *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 60–71 refs (See N65-32506 21-25)

The roots of a frequency equation are investigated and solved for various conditions, for understanding the role of radiation in damping processes, and in the dispersion of pressure waves. Wave absorption coefficients are calculated. Computations are shown for isothermal waves, and waves of great and small optical length. L.S.

N65-32524 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

FLOW OF AN ELECTRICALLY CONDUCTIVE LIQUID IN A FLAT MAGNETO-HYDRODYNAMIC CHANNEL

E. P. Eimin *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 171–178 refs (See N65-32506 21-25)

The flow of an electrically conductive liquid between two flat infinite parallel conductive plates is considered for the case when the vector of magnetic field strength lies in a plane parallel to the plates. Dimensionless variables and parameters are introduced into the system of equations generally used for describing the stationary flow of an incompressible viscous fluid with anisotropic conductivity in a magnetic field, and new equations are derived for solving the problem. It was determined that all parameters can be expressed through current density. Calculations are also shown for the case of vertical convection between infinite parallel plates maintained at various temperatures, and for the case of isotropic conductivity. A graph showing the dependency of the liquid flow rate on the load parameter over various Hartman numbers is presented for the latter case. L.S.

N65-32532 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DIFFUSION THEORY OF MOBILE STRATA

I. V. Kamenev and V. A. Pogosyan *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 226–232 refs (See N65-32506 21-25)

Calculations proving the existence of a mathematical solution to the problem of determining the modulation percentage of electron concentration are presented, and are compared with an approximation made from experimental data. Diffusion and electron distribution were studied for helium gas ionized in a cylindrical tube at 1 mm Hg pressure. The approximate solution obtained is plotted in the form of a trigonometric polynomial, and corresponds to the mathematical solution. The plotted data, approximated with respect to the speed of ionization, z, values, show that the electron temperature in electron volts U_e and z have maximums at $x \approx 1.8$ cm. Maximum for electron concentration is attained at a length ≈ 3.5 cm. The difference of distance Δx between the electron temperature maxima, speed of ionization, and electron concentration is approximately equal to 1.5 cm. Modulation percentage obtained for the electron concentration ≈ 2 times. L.S.

N65-32534 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE INTERACTION OF AN EXPANDING PLASMA COLUMN WITH AN EXTERNAL MAGNETIC FIELD

V. I. Yakovlev *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 239–243 refs (See N65-32506 21-25)

The interaction of an expanding plasma column with a constant external magnetic field is considered for studying the relationships between the energy magnitudes. The dependence of internal efficiency $n_i = (A - Q)/A$ on the magnetic Reynolds number R_m was considered for particular cases of the expansion. A is the work of plasma in terms of emf per unit of time, and Q is the intensity of Joule losses in a plasma. Both magnitudes A and Q are obtained in reference to a unit of column length. The problem of an expanding plasma column with constant conductivity σ located parallel to the vector of a homogeneous magnetic field is discussed, and calculations are shown for the cases where $f(x) = \alpha/x$ (α is an arbitrary constant), and where f(x) = constant = 1/2 when substituted in the formula used for determining the magnetic field. An expression for the total derivative of magnetic flux, and for Q/A is derived. An application of the calculations is given showing the determination of a constant for a given set of conditions. L.S.

N65-32535 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

RAYLEIGH-TAYLOR INSTABILITY IN A CONICAL PLASMA ACCELERATOR

R. Kh. Kurtmullayev, Yu. Ye. Nesterikhin, and A. G. Ponomarenko *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 244–248 refs (See N65-32506 21-25)

Experiments designed to detect hydromagnetic instability in conical plasma accelerators are described. Two types of conical sources, differing in geometric dimensions, were used. Streak camera pictures were taken of the cluster formed, and measurements with a Rogowski loop and magnetic probes showed the existence of currents for both the ϕ and z components of the photographed cluster, whose duration was on the order of the period of discharge. As the plasma advances along the pipe, the duration of the region in which adequate current can exist increases and spreads, and the density of plasma in the region drops shbply. The experiments indicate that for obtaining plasmoids with optimum parameters, the instability appearing in these clusters complicates not only their movement, but also their introduction into different magnetic trap systems. L.S.

N65-32536 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

LAYERS POTENTIAL VARIATION ADJACENT TO AN ELECTRODE DURING TRANSMISSION OF A WEAK CURRENT THROUGH AN IONIZED GAS

G. A. Lyubimov *In its* J. of Appl. Mech. and Tech. Phys., No. 6, 9 Apr. 1965 p 249–254 refs (See N65-32506 21-25)

Expressions for current density are used with expressions for determination of variation in potential in ad-electrode layers $\phi \pm$ through current density flowing through a gas, and the resulting calculations of the volt-ampere curve are plotted. The curve corresponds well to experimental data from the literature. Thus the method of calculation and the assumptions made for expressing the current density is shown to be applicable to the problem of constructing a nonlinear volt-ampere curve to which a potential difference is applied, at least as long as the potential drop in the ad-electrode layers is small ($\phi \pm \leq U_i$, U_i is the ionization potential of the additions). The condition is fulfilled in the calculations. L.S.

N65-32537 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON CERTAIN PECULIARITIES OF BURNING OF AN ELECTRIC ARC IN A DC PLASMATRON

V. Ya. Smolyakov *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 255–264 refs (See N65-32506 21-25)

Experiments were conducted on a DC plasmatron for investigating arc oscillations during burning. A diagram of the plasmatron is presented. It was shown that the electrical arc undergoes continuous changes in length, voltage, and current. The changes are caused by the peculiarities of its burning with the location of part of the positive column along the axis of the electrode channel, through which the gas passes from the plasmatron, where the arc is closed on one end to this electrode. Oscillations of arc voltage under certain conditions reached 40% to 50% of the mean value. The mechanism of the establishment of mean arc voltage in the plasmatron, and the significant influence of the change in electrode polarity on the magnitude of mean arc voltage is explained. L.S.

N65-32573*# Electro-Optical Systems, Inc., Pasadena, Calif.

FOLLOW-ON INVESTIGATION OF A STEADY STATE HALL CURRENT ACCELERATOR Final Report

G. L. Cann and R. L. Harder 30 Oct. 1964 106 p refs (Contract NAS3-3568)

(NASA-CR-54062; EOS-4010-Final) CFSTI: HC $4.00/MF $0.75 CSCL 20I

A model of the electromagnetic interaction with the plasma has been postulated. Plasma is generated near the surface of the electrodes. This plasma flows downstream in an inner core and an outer cylinder, separated by a non-conducting layer. Far downstream, the two layers join together. The electric current path from anode to cathode is via this long loop. An external solenoidal magnet produces a diverging magnetic field in the region. The axial current in the outer cylinder and the applied radial magnetic field cause tangential Hall currents. These Hall currents in the jet interact with the radial magnetic field to produce the thrust. The reaction of this thrust is in the magnet. The Hall currents induce a magnetic field which tends to let the accelerated plasma flow unimpeded out of the applied magnetic field. Several models of the accelerator have been tested. Author

N65-32605# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

NEWS OF THE ACADEMY OF SCIENCES OF THE USSR, PHYSICS SERIES Selected Articles

7 Jul. 1965 18 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Fiz. (Moscow), v. 28, no. 6, 1964 p 996–997, 998–999, 1096–1099

(FTD-TT-65-657/1+2+4; AD-618046)

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1. CERTAIN PROPERTIES OF THIN INDIUM PHOSPHIDE LAYERS Ya. A. Ugay, Ye. M. Averbakh, R. L. Fogel'son, and V. A. Gol'dfarb p 1–4 refs (See N65-32606 21-26)

2. CERTAIN ELECTRICAL AND GALVANOMAGNETIC PROPERTIES OF INDIUM ARSENIDE FILMS V. A. Kas'yan p 5–8 refs (See N65-32607 21-26)

3. INVESTIGATING CERTAIN PHYSICAL PROPERTIES OF $CuSbS_2$ AND $CuSbSe_2$ SINGLE CRYSTALS G. B. Abdullayev, R. Kh. Nani, Ya. N. Nasirov, and T. G. Osmanov p 9–17 refs (See N65-32608 21-26)

N65-32612# Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.

PROPAGATION CONSTANT ALONG A CYLINDRICAL ANTENNA IMMERSED IN A WARM PLASMA (PARTS I AND II) Scientific Report No. 6

S. R. Seshadri and Janis Galejs Bedford, Mass., AFCRL, Apr. 1965 31 p refs

(Contract AF 19(628)-2410)

(S-3040-6; AFCRL-65-371; AD-618396)

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1. PROPAGATION COEFFICIENT FOR THE CURRENT DISTRIBUTION ALONG A CYLINDRICAL ANTENNA IMMERSED IN A WARM LOSSLESS PLASMA S. R. Seshadri 19 p refs (See N65-32613 21-25)

2. PROPAGATION ALONG AN INSULATED CYLINDRICAL WIRE IN A COMPRESSIBLE LOSSY PLASMA J. Galejs 9 p refs (See N65-32614 21-25)

N65-32613 Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.

PROPAGATION COEFFICIENT FOR THE CURRENT DISTRIBUTION ALONG A CYLINDRICAL ANTENNA IMMERSED IN A WARM LOSSLESS PLASMA

S. R. Seshadri *In its* Propagation Current along a Cylindrical Antenna Immersed in a Warm Plasma (Pt. I and II) Apr. 1965 19 p refs (See N65-32612 21-25)

A perfectly conducting, infinitely long cylindrical wire surrounded by an insulating layer of a cylindrical sheath of

free space is immersed in a homogeneous, warm plasma of infinite extent. Using the linearized plasma theory and approximate boundary conditions, the dispersion equation for the propagation coefficient along the wire is derived. The numerical solution of the dispersion equation for a wide range of values for the radius of the cylindrical wire and the width of the insulating sheath shows that the propagation coefficient along the cylindrical wire is close to that of the plasma mode in an unbounded plasma, in the frequency range for which the electromagnetic and the plasma space waves are excited, that is for frequencies above the plasma frequency. It is therefore concluded that for a finite antenna immersed in a warm plasma without or with an insulating sheath, it is appropriate to include in the approximation for the current distribution along the antenna part which has the propagation coefficient of the order of magnitude of the P wave. Author

N65-32614 Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.
PROPAGATION ALONG AN INSULATED CYLINDRICAL WIRE IN A COMPRESSIBLE LOSSY PLASMA
Janis Galejs *In its* Propagation Current along a Cylindrical Antenna Immersed in a Warm Plasma (Pt. I and II) Apr. 1965 9 p refs (See N65-32612 21-25)

The distribution of current on an antenna immersed in a compressible plasma will be characterized by the propagation constants of waves guided along the antenna. The dispersion relations for the plasma waves of this problem have been examined for a lossless plasma. However, there will be also guided EM waves the propagation of which may differ from that of EM space waves. The purpose of this work is to examine the propagation characteristics of both the EM and P waves that are guided along the infinitely long antenna by considering also the plasma losses. Significant radiation of the antenna occurs only for frequencies above the plasma frequency and the considerations will be restricted to this frequency range. The problems of a finite antenna are not treated at present. Author

N65-32712# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
EFFECT OF THE KINETICS OF CONTAMINANTS ON WAKE IONIZATION
J. Eckerman, R. Buck, H. Lien, and D. Argentini Jun. 1965 80 p refs
(Contract DA-31-124-ARO-D-218; ARPA Order 553; Proj. Defender)
(RAD-TM-65-30; AROD-5136-6; AD-618074)

Experimental values for recombination rates between electrons and cesium ions are presented in this report. Measurements cover temperatures from 4300° K to 1200° K at electron densities from 1.5 (10^{14}) to 2 (10^{12}) cc^{-1}. The cesium plasma is generated by a high-velocity steel spherical projectile fired into a special chemical kinetics ballistic range. Microwave P-band and Ka-band focused probe measurements of electron density were made as a function of time at two wave locations. Measured and calculated electron density decays are shown to agree satisfactorily. The experimental recombination rates are compared to theoretical values from Bates, Kingston, and Mc Whirter; agreement is reasonable. The experimental apparatus and techniques are described in detail in the report. Author

N65-32772# Harvard Univ., Cambridge, Mass. Cruft Lab.
ANTENNA INSIDE A MAGNETOPLASMA-FILLED PARALLEL-PLATE WAVEGUIDE Scientific Report No. 11, Series 3
B. Rama Rao 15 Mar. 1965 23 p refs
(Contract AF 19(628)-2406; Grant NSF GP-851)
(AFCRL-65-401; AD-617928)

An antenna inside a magnetoplasma-filled parallel-plate waveguide is considered. Its behavior at the Pythagoras (upper hybrid resonance) frequency and the plasma resonance frequency has been studied. The effect of the magnetoplasma medium on the feed-point singularity of the antenna current has also been investigated. Author

N65-32786# Princeton Univ., N. J. Plasma Physics Lab.
THE SPECTRUM OF LOW-β PLASMA TURBULENCE
Francis F. Chen Aug. 1965 11 p refs
(Contract AT(30-1)-1238)
(MATT-359)

Equations which attempt to explain the shape of the frequency spectrum of plasma are described. A universality of the spectrum under diverse conditions indicates the final turbulent state is independent of the excitation mechanism, provided that there is sufficient time for the instability involved to reach its limiting amplitude. Drift waves were proposed as the sole cause of anomalous transport in dense low-β plasmas. Caution in interpreting probe data at the high frequency end of the spectrum is recommended, because of probe frequency response and a diameter comparable to wavelength. W.M.R.

N65-32811# Princeton Univ., N. J. Plasma Physics Lab.
INTERACTION OF ELECTRON BEAMS WITH INHOMOGENEOUS PLASMAS
Francis F. Chen Aug. 1965 8 p refs
(Contract AT(30-1)-1238)
(MATT-364)

The possibility that the large amplitude low-frequency oscillations superimposed on radio-frequency oscillations in experiments on the interaction of electron beams with a plasma are drift waves excited by the beam, was investigated. Solid curves showing the dispersion relation for drift waves in a low-density inhomogeneous plasma in a uniform magnetic field are shown. A dispersion relation is obtained for a system of four components and calculations are given. L.S.

N65-32812# Princeton Univ., N. J. Plasma Physics Lab.
LOSS RATE OF CHARGED PARTICLES FROM OHMICALLY HEATED DISCHARGES IN THE C STELLARATOR
E. Hinnov and A. S. Bishop Aug. 1965 26 p refs
(Contract AT(30-1)1238)
(MATT-356)

Ionization rates in the C stellarator discharges of helium and hydrogen, with ohmic heating, are deduced from measured electron densities, temperatures, and the intensities of certain spectrum lines. Knowledge of ionization rates, together with the observed rate of change of the electron density, yields the loss rate of charged particles. It is shown that the average charged particle confinement time varies linearly with the confining field and the aperture of the current channel, and inversely with the electron temperature. The confinement time is the same for helium and hydrogen and is not explicitly dependent on ohmic heating current or particle density. Author

N65-32825# Stanford Univ., Calif. Dept. of Mechanical Engineering.
AN ARC PLASMA GENERATOR FOR THE STUDY OF PARTIALLY IONIZED GASES Technical Report No. 4
Richard E. Steere Jun. 1964 67 p refs
(Contract AT(04-3)-247)
(SU-247-6)

The design, construction, and operation of an arc plasma generator are described. The basic arc design was shown to be sound and functional, and capable of continuous operation at levels of current up to 750 amps. The arc generator withstood the testing program with no apparent deterioration. Electrode life, although shortened during test runs as a result of operating inexperience, is estimated to be in excess of 100 hours under laboratory test conditions. Instrumentation is adequate for normal operation. Plasma enthalpies up to 6000 Btu per lb were obtained, and both electrical and thermal characteristics were determined with reasonable accuracy. It is possible to predict arc performance qualitatively and to specify quantitative performance for given operating conditions. Detailed design and construction information is given in the appendices. R.N.A.

N65-32838# Sandia Corp., Albuquerque, N. Mex.
INVESTIGATION OF THE FERROELECTRIC PROPERTIES OF LEAD ZIRCONATE-TITANATE WITH STRONTIUM AND BARIUM ADDITIONS
C. A. Hall and R. L. Cook Aug. 1964 23 p refs
(Contract AT(29-1)-789)
(SC-TM-64-670)

This memorandum presents the results of an investigation of effects when lead was partially replaced by strontium or barium in lead zirconate-titanate solid solutions in the region of the ferroelectric-antiferroelectric phase boundary. Composition-temperature phase diagrams are presented to show the dielectric and ferroelectric properties measured. Substitution of barium favored the FE phase with only a small AFE area near $PbZrO_3$. Barium also markedly lowered the FE_1-FE_{11} transition temperature. The replacement of lead by strontium increased the amount of titanium necessary to bring the onset of ferroelectricity and also reversed the stability of the FE and AFE phases with respect to temperature. The ferroelectric properties, although altered to some extent by barium and strontium, were not greatly changed. Author

N65-32851# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SEMICONDUCTORS GENERATE LIGHT
N. G. Basov 7 Jul. 1965 9 p Transl. into ENGLISH from Pravda (Moscow), 5 Jan. 1964 p 3
(FTD-TT-65-337/1+4; AD-618013)

A brief discussion of Russian research on semiconductor quantum generators is presented. Comparisons are made between semiconductor generators and generators of other types (ruby crystal, glass, and gas). The comparisons cover dimensions, radiated power, vibration mode, and efficiency. The use of the semiconductor quantum generator as an exceptionally economical source of light is discussed, and other promising applications are considered. M.R.W.

N65-32891# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
THE INTERACTION OF THE FAST PLASMOIDS WITH THE STATIC MAGNETIC FIELD BARRIER [VZAIMODEYSTVIE BYSTRYKH PLAZMOIDOV S BARIEROM POSTOIANNOGO MAGNITNOGO POLA]
S. Khvashchevski Mar. 1965 23 p refs in RUSSIAN; ENGLISH summary
(Rept.-612/IXA/PR)

The interaction of the fast plasmoids with the external magnetic barrier was investigated. Radial focusing and deceleration of the plasma were observed. From the amplitude of the diamagnetic signals, the value of the plasma density and the internal plasma energy has been determined using the analog computer. Author

N65-32906# Princeton Univ., N. J. Plasma Physics Lab.
PRODUCTION OF A THERMALLY IONIZED PLASMA WITH NEGATIVE IONS
S. von Goeler, T. Ohe, and N. D'Angelo Aug. 1965 13 p refs
(Contract AT(30-1)-1238)
(MATT-357)

The hot tungsten plates of the Q-3 device are bombarded with a beam of CsCl molecules instead of the usual Cs atoms. According to a calculation of the thermodynamic equilibrium the plasma should contain an appreciable fraction of Cl^- ions. Measurements of the plasma density have been performed in the range 10^{11}- 10^{12} cm^{-3}. The negative ions have been detected with a small mass spectrometer. Author

N65-32924# Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.
THE PRODUCTION OF DENSE BEAMS OF LOW-ENERGY IONS
M. J. Kofoid, C. M. Braams, and P. Zieske Jun. 1965 15 p refs
(DI-82-0436)

Dense beams of positive ions of less than 1.0 keV energy have been produced using a duoplasmatron with an extraction voltage of 20 kV as a source. Outward radial electrostatic forces due to space charge impose a restriction upon the intensity of an ion beam while it is being formed in vacuum. This paper discusses the problem of designing the electrostatic lens system for decreasing the energy of the ions while simultaneously focusing them to produce a maximum-density parallel beam. The system consisted of a unipotential lens, which was integral with the source (Radiation Dynamics Type DY-1), and two additional immersion lenses. Most of the deceleration and beam compression was accomplished in the last lens. Its design was the major problem. Because a fairly exact analysis would have been very complicated, a simple approximate method for designing this lens was devised. The design values of current in the final low-energy beam checked well with those from experiment. Author

N65-33011# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MASS MONOCHROMATOR WITH DOUBLE FOCUSING IN A MAGNETIC SECTOR FIELD
V. A. Molchanov and V. G. Tel'kovskiy 13 Jul. 1965 16 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. I: Mat. i Mekhan. (Moscow), no. 1, 1961 p 22–28
(FTD-TT-65-697/1+2+4; AD-618015)

An arrangement designed for experiments with ion beams and also for separating small quantities of isotopes, is described. The use of double focusing in a magnetic sector field made it possible to obtain a dispersion of 1 cm per 1% relative mass difference and an ion current density close to the focus up to 2–3 ma/cm^2 for a relatively small magnet weight. Author

N65-33038# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
PRELIMINARY STUDIES ON THE CLOSED CYCLE MAGNETOAERODYNAMIC CONVERTER [ETUDES PRELIMINAIRES SUR LES CONVERTISSEURS MAGNETOHYDRODYNAMIQUES FONCTIONNANT HORS D'EQUILIBRE THERMODYNAMIQUE]

Pierre Ricateau 1964 15 p refs In FRENCH; ENGLISH summary
(CEA-R-2686) CFSTI: HC $1.00/MF $0.50

Besides the open cycle MHD converters which convert the thermal energy contained in combustion gases, a closed cycle converter which can work with any high temperature heat source and specially with nuclear sources is being very carefully studied. Before proceeding to a practical study of the power station as a whole, the performances of the converter itself must be fully investigated. These performances are largely a function of the conductivity of the gas, but this conductivity must not be repaid by a temperature technically unacceptable for the heat exchanger. In the conversion fluid an ionizable seeding vapor such as cesium or potassium is mixed with a carrier gas, helium or argon. Purely thermal ionization is only efficient above 2,500° K, whereas the electric field obtained by induction in the converter can, under given conditions, increase the electron temperature and produce an ionization rate well above the equilibrium value. This allows the gas to be ionized at moderate temperature. Studies are under way in order to clarify the conditions required to produce extra-thermal ionization in seeded rare gases. Author

N65-33116# Harvard Univ., Cambridge, Mass. Engineering Sciences Lab.
INVESTIGATION OF THE HIGH PRESSURE HELIUM ARC PLASMA BY MICROWAVE CAVITY TECHNIQUES
William T. Maloney Jun. 1965 34 p refs
(Grant NSF GK-65)
(TR-17)

A steady state atmospheric pressure helium arc plasma flowing through a 1 cm circular copper pipe at a flow of 7240 ml/min is studied by microwave cavity diagnostic techniques. Arc curren—range from 5 to 30 Amp. The measurement of a microwave cavity resonant frequency is interpreted as a measurement of the diameter of the plasma column. The diameters, however, exhibit a transient and an irreproducibility in final values which is attributable to contamination of the arc. The effects on the arc current of adding controlled amounts of argon and nitrogen to the arc show that levels of a few parts per million produce significant dilation of the column. This dilation is attributed to seeding with electrons by gases having ionization potentials less than that of helium. At higher contaminant levels, nitrogen produces a contraction of the column. It is concluded that the microwave cavity technique provides an extremely sensitive monitor of the state of gas purity. C.T.C.

N65-33121# Innsbruck Univ. (Austria). Inst. for Theoretical Physics.
MHD CHARACTERISTICS AND DISPERSION RELATION FOR FINITE ELECTRICAL CONDUCTIVITY
Helmut Friedel 13 Mar. 1965 15 p refs
(Contract AF 61(052)-675)
(SR-23; AFOSR-65-1313; AD-617898) CFSTI: HC $1.00/MF $0.50

Expressions for the dispersion of linear waves are derived as solutions of hyperbolic partial differential equations. These expressions are analyzed as the basic magnetohydrodynamic equations for finite electrical conductivity. J.M.D.

N65-33160# New York Univ., N. Y. Magneto-Fluid Dynamics Div.
LONGITUDINAL PLASMA OSCILLATONS
Harold Weitzner 1 Jun. 1965 48 p refs
(Contract AT(30-1)-1480)
(MF-46; NYO-1480-26)

The problem of the plane wave oscillation of a one-dimensional plasma is considered. Various asymptotic expansions of the solution for a stable plasma are presented. First, an expansion is given for short time valid for arbitrary wavelengths. Second, expansions are given for long wavelengths valid over a long time interval. The mixed initial value-boundary value problem is solved for the case of harmonic time-dependent data given on a wall. It is shown that for stable plasmas the electric field approaches a limiting form in time. The specular reflection boundary condition is solved as a special case. The limiting electric field is characterized by an analyticity condition analogous to those obtained from causality conditions in scattering theory. Finally, asymptotic expansions are given where the small parameter analogous to wave number is the deviation of the frequency of oscillation from the plasma frequency. Author

N65-33228# National Bureau of Standards, Washington, D. C.
SENSITIVITY INDICES FOR HALL GENERATORS
Sherwin Rubin and George J. Rogers 6 Feb. 1964 25 p
(NBS-TN-233) GPO: $0.20

The Hall generator is usually characterized as a product-sensitive device, but product sensitivity (the ratio of the Hall voltage to the product of control current and magnetic induction) is unsatisfactory as a figure of merit for many applications. For this reason, two additional sensitivity indices, one a measure of the effect of magnetic induction on output voltage and the other a measure of the effect of control current on output voltage, are proposed, defined, and illustrated by an example. Author

N65-33282*# Virginia Univ., Charlottesville. Research Labs. for the Engineering Sciences.
A STUDY OF THIN FILM VACUUM DEPOSITED JUNCTIONS
Semiannual Status Report, 5 Dec. 1964–5 Jun. 1965
Robert L. Ramey Jul. 1965 39 p refs
(Grant NsG-340)
(NASA-CR-64812; EE-4012-140-65U) CFSTI: HC $2.00/MF $0.50 CSCL 20L

Research activities have been concerned with effects of surface states and grain boundaries on free carrier concentration, mobility, and mean free path of the charge carriers in thin films; the design of a boat for the evaporation of insulating films such as SiO; and experimental investigations related to the design and fabrication of thin film electronic devices. A theoretical expression for current density in polycrystalline films was found which yields a barrier potential of 0.0851 in agreement with a value of 0.095 previously observed for CdS films. Space charge effects in thin films and a new SiO sublimation source are considered. Electron tunneling calculations are given. M.W.R.

N65-33293# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etude Nucleaires.
DETERMINATION OF THE PHYSICAL VALUES OF A PLASMA PUFF BY ANALYSIS OF THE DIAMAGNETIC SIGNALS. FIRST PART: EXPANSION FOR THE PUFF [DETERMINATION DES GRANDEURS PHYSIQUES D'UNE BOUFFEE DE PLASMA PAR L'ANALYSE DE SIGNAUX DIAMAGNETIQUES. PREMIERE PARTIE: MODELE D'EXPANSION DE BOUFFEE]
Jean Jacquinot, Christian Leloup, Jean-Pierre Poffe, and Francois Waelbroeck Oct. 1964 76 p refs In FRENCH; ENGLISH summary
(CEA-R-2617; EUR-1916.f) CFSTI: HC $3.00/MF $0.75

The flow of a dense plasma puff, along the axis of a uniform magnetic field is examined, assuming the following hypotheses: the axial distribution of the line density can be described at any time by a gaussian function whose characteristic parameter is independent of the distance from the axis of the system; the β ratio is less than 0.6. An approximate solution of the magneto-hydrodynamics equations is obtained. The evolution of the characteristic properties of the plasma (local velocity, temperature and density) can be calculated from a set of equations involving 5 plasma parameters. A method leading to the determination of these parameters is described. It uses 5 informations picked up from the diamagnetic signals induced by the plasma into a set of 4 compensated magnetic loops. Author

N65-33300# California Univ., Berkeley. Electronics Research Lab.
THE TWO-STAGE MAGNETIC MIRROR COMPRESSION EXPERIMENT WITH A ROTATING PLASMA SOURCE
H. K. Forsen 7 Jun. 1965 158 p refs
(Grants AF-AFOSR-139-64; NSF GP-2239; Contract AF 33-(615)-1078)
(Rept.-65-16)

A two-stage magnetic mirror compression experiment was constructed to investigate a rotating plasma as a clean, high-temperature plasma source. Kilovolt deuterons were created in the crossed electric and magnetic fields of the first stage and were transferred or injected into the second stage. Measurements were made on the plasma to determine energy density, ion energy distribution, electron temperature, impurity content, and neutron flux. To transfer the plasma out of the first stage to the second stage, two methods were used: one involved sequentially energizing the first stage magnetic field coils to move the plasma into the second stage mirror field; and the other involved ionization in a gradient field which directly injects the plasma into the second stage. In the process of transfer, the plasma leaked out of the first stage. The escaping deuterons were given additional axial acceleration by the fringing electric field at the tip of the anode which extends through the first stage and ends between the two stages.
R.W.H.

N65-33327# Massachusetts Inst. of Tech., Cambridge.
EXPERIMENTAL MEASUREMENT OF THE GROWTH OF A TURBULENT MERCURY JET IN A COAXIAL MAGNETIC FIELD
Miklos Sajben and James A. Fay Jul. 1965 39 p refs Submitted for Publication
(Contracts Nonr-3623(00); AF 19(828)-221; Proj. Squid)
(MIT-38-P; AD-468563)

Using a hot wire system developed for this purpose, measurements of the velocity were made in a circular liquid mercury jet issuing into a low speed secondary flow and subject to a uniform axial magnetic field. The Reynolds number of the jet was about 10,000 while the magnetic interaction parameter varied from zero to slightly over one. The jet was strongly turbulent under all conditions investigated. The radial distribution of the mean and fluctuating component of the meridional velocity was measured at four axial stations located between 2 and 34 diameters from the nozzle exit. The results indicate that the rate of spreading of the jet is decreased, that the shape of the velocity profile changes and that the turbulent intensity decreases with increasing magnetic field strength. The high frequency components of the fluctuations in the secondary flow seem to be damped more strongly than fluctuations at low frequencies, while the reverse is observed within the core of the jet. Author

N65-33328# Massachusetts Inst. of Tech., Cambridge.
INSULATOR ABLATION IN MAGNETIC PISTON SHOCK TUBES
J. B. Workman Jul. 1965 34 p refs Submitted for Publication
(Contract Nonr-3623(00); Proj. Squid)
(MIT-39-P; AD-468564)

The effect of end wall insulator ablation on the performance of magnetic piston shock tubes has been investigated theoretically. From the analysis of a steady flow model, a simple correlation parameter has been derived that permits a quick determination of the loss in a given experiment. The parameter is a function only of the magnetic drive field, initial test gas density, and the ionization energy of the insulator vapor. The transient heating of the insulator that initiates the vaporization is discussed as is the effect of degassing adsorbed material at the wall surface. Author

N65-33332# Aberdeen Proving Ground, Md. Ballistic Research Labs.
ON THE USE OF VACUUM ULTRAVIOLET ABSORPTION AS A MEASURE OF TEMPERATURE IN RARE GAS PLASMAS
R. A. Rudd Apr. 1965 23 p refs
(BRL-MR-1644; AD-468537)

Blackwell, Bajwa, Shipp, and Weissler have shown that properties of shocked rare gas plasmas can be investigated with the use of absorption in the vacuum-ultraviolet. It is shown that an equilibrium temperature behind the shock can be obtained, if the strong shock approximation is valid. In the following paper, it is shown that this experimental technique can be used to determine temperature even in unshocked gases. A survey of available photoionization cross sections is made, and improvements in the experimental method are suggested. Author

N65-33407# Rome Air Development Center, Griffiss AFB, N. Y. Instrumentation Branch.
THE PROPAGATION OF WAVES ACROSS A MAGNETO-PLASMA-VACUUM BOUNDARY Interim Report
Robert L. Gallawa Jun. 1965 53 p refs
(RADC-TR-65-183; AD-468218)

The coupling of electroacoustic and electromagnetic energy at a magnetoplasma-vacuum boundary is studied via the plane wave solution of Maxwell's equations. The effect of the static magnetic field is illustrated graphically. Author

N65-33489# AVCO-Everett Research Lab., Everett, Mass.
ANOMALOUS ELECTRON DIFFUSION AND ION ACCELERATION IN A LOW DENSITY PLASMA
G. S. Janes and R. S. Lowder Jul. 1965 33 p refs Submitted for Publication
(Contracts AF 49(638)-659; AF 49(638)-1553)
(AVCO-Everett-Res. Rept.-224; AD-469878)

Ion and electron transport properties have been measured in a steady state, weakly turbulent plasma that was subjected to crossed E and B fields. The geometry permits quantitative measurements of electron and ion currents. The ion gyro radius is large compared to the apparatus dimensions. Measurements of the potential gradients, Hall currents and ion velocity show that the ions are freely accelerated through the plasma by electrostatic forces. However, an "anomalous diffusion" of electrons is observed since the electron current across the magnetic field is much too large to be due to collisional diffusion. The plasma is weakly turbulent, consisting of a slowly rotating

density concentration on which higher frequency fluctuations are superimposed. Electric field fluctuations are found that are correlated with the density variations so as to produce the "anomalous diffusion" via adiabatic E × B drifts. The magnitudes of these electric field and density variations are used to predict a net electron current that agrees with the direct measurements of this current. Reasonable agreement with the turbulent diffusion theory of Yoshikawa and Rose is obtained. Author

N65-33519# Space Technology Labs., Inc., Redondo Beach, Calif. Physical Electronics Lab.
RESEARCH ON CHARGED COLLOID GENERATION Progress Report, 25 Jan.–25 Feb. 1964
E. Cohen [1964] 7 p *Its* Rept. No. 9
(Contract AF 33(657)-10999)
(STL-8421-6009-SU-000; AD-461051)

The multi-needle module was redesigned from an array containing 10 capillary tubes to one containing 37 capillary tubes. By this method it is hoped that seven modules containing 133 needles can be replaced with a single module. Also, the four inch radius of curvature collector was replaced with an eight inch radius of curvature collector; the 90° total field angle was retained. Photographs of the polishing technique for the capillary tube tips, of the 37 needle module, and the 8 inch collector are included. E.E.B.

N65-33531# Advanced Technology Labs., Mountain View, Calif.
THE PLASMA GUN AND ITS APPLICATIONS [LE CHALUMEAU A PLASMA ET SES APPLICATIONS]
H. Marchandise Brussels, EURATOM, Jun. 1965 244 p refs In FRENCH; ENGLISH summary Prepared in part at Joint Nucl. Res. Center, Ispra Estab., Italy
(Contract AT(04-3)-250)
(EUR-2439.f) CFSTI: HC $6.00/MF $1.50

The main subject of this report is introduced by a review of the main properties of the electric arcs and more particularly of the constricted type of arc. Data on plasma properties are also reviewed. The second part of the report is devoted to the study of the plasma gun itself and the jet of plasma that it produces. Data are given on the influence of several parameters on the electrical characteristics and on the thermal efficiency of a plasma gun. The main parameters examined in detail are: gas flow, nature of the gas, electrode spacing, voltage and current. Results are discussed and correlated with some general data on the constricted arcs. Author

N65-33546*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ENERGY ADDITION TO AN ATOMIC HYDROGEN PLASMA AT OFF-RESONANT CONDITIONS
Richard R. Woollett Washington, NASA, Sep. 1965 45 p refs (NASA-TN-D-2982) CFSTI: HC $2.00/MF $0.50 CSCL 20I

The efficiency of energy addition to a plasma by means of a Stix coil was determined for off-resonant conditions. The results included effects of cyclotron damping and axial temperature. The coupling resonance was found to be much sharper than had been predicted previously. Additional maxima in power absorption were found at slightly higher magnetic fields. These off-resonant maxima exhibited magnitudes and breadths that made them appear well suited to plasma heating. These new maxima appeared because of a beat phenomenon between the forced and natural plasma waves. Author

N65-33547*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ACCELERATION OF A CONDUCTING FLUID BY A TRAVELING MAGNETIC FIELD
Willis H. Braun Washington, NASA, Sept. 1965 32 p refs (NASA-TN-D-3006) CFSTI: HC $2.00/MF $0.50 CSCL 20I

An analysis is undertaken for the traveling-wave accelerator with the propellant having scalar conductivity. Two configurations of magnetic field are studied. The first employs a field perpendicular to the line of motion and varying sinusoidally. When the conductivity is assumed proportional to the density, the analysis shows that the propellant is ejected in dense pulses, there is an upper limit on efficiency of about one-half, and the acceleration to wave velocity can be performed on one magnetic field wavelength if a defined interaction parameter has a value of order one. Another accelerator using a magnetic wave such as might be produced by coils surrounding the channel has a somewhat lower efficiency, which is due mainly to the loss of propellant to (or through) the boundaries. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N65-32475# Advisory Group for Aeronautical Research and Development, Paris (France).
ADVANCES IN MATERIALS RESEARCH IN THE NATO NATIONS
H. Brooks, N. H. Mason, N. E. Promisel, and G. H. Cooper ed. Oxford (New York), Pergamon, 1963 535 p refs Proc. of a NATO Symp. Organ. By the Struct. and Mater. Panel of AGARD (AGARDograph-62) CFSTI: HC $8.35/MF $2.50

Research on polymer structure, phase properties of solids, dislocation theory, ferromagnetism and antiferromagnetism, and thermal and electrical conductivity of metals is reported, and the organization of manrials research in the member nations of NATO is described. For individual titles see N65-32476–N65-32505.

N65-32481 Paris Univ., Orsay (France).
A STRUCTURAL STUDY OF THE PRECIPITATION AND DEFECTS CREATED BY IRRADIATION [ETUDE STRUCTURALE DE LA PRECIPITATION ET DES DEFAUTS CREES PAR IRRADIATION]
A. Guinier *In* AGARD Advan. in Mater. Res. in the NATO Nations 1963 p 77–95 refs In FRENCH (See N65-32475 21-26) CFSTI: HC $8.35/MF $2.50

Detection of defects created in crystal lattices by the precipitation process involved in forming alloys, and by irradiation, are discussed. Neither electron microscopy nor X-ray diffraction appear able to reveal all of the defects which are pertinent to description of the physical characteristics of crystalline material. Transl. by J.M.D.

N65-32483 Max-Planck-Institut für Metallforschung, Stuttgart (West Germany).
CURRENT STATUS OF DISLOCATION THEORY
Alfred Seeger *In* AGARD Advan. in Mater. Res. in the NATO Nations 1963 p 103–116 refs (See N65-32475 21-26) CFSTI: HC $8.35/MF $2.50

The theoretical study of the properties and the behavior of dislocation in crystals (energies and stress fields, interactions between dislocations or between dislocations and point defects) are under study. The majority of the verifications of dislocation theory by direct observations pertain to geometrical properties of dislocations. A number of theoretical methods were recently developed permitting quantitative calculation on energies, electrical and thermal resistivities of dislocations. These methods were divided into two groups, according to whether they were entirely based on the mechanics of continua, or the electron theory of metals or the lattice theory of crystals. The majority of approaches use methods that were developed for the study of point defects. Two examples for the application of the electron theory of metal are mentioned: the calculation of the electrical resistivity of dislocation, and the calculation of jog energies in extended dislocations. R.W.H.

N65-32484 Laboratoires du Centre d'Etudes de l'Energie Nucleaire, Mol (Belgium).
THE DIRECT OBSERVATION OF DISLOCATIONS
S. Amelinckx *In* AGARD Advan. in Mater. Res. in the NATO Nations 1963 p 117–169 refs (See N65-32475 21-26) CFSTI: HC $8.35/MF $2.50

A number of methods developed for the direct study of dislocations are reviewed. Some specific examples are: (1) surface methods—growth, evaporation, and etching; (2) bulk methods—decoration, X-ray diffraction, and birefringence; and (3) thin film methods—transmission electron microscopy, direct resolution of the crystal lattice, and moire patterns. To solve a particular problem a combination of several mehods is often required. R.W.H.

N65-32489 Illinois Univ., Urbana. Dept. of Physics.
SUPERCONDUCTIVITY
John Bardeen *In* AGARD Advan. in Mater. Res. in the NATO Nations 1963 p 281–291 refs (See N65-32475 21-26) CFSTI: HC $8.35/MF $2.50

An outline of the physical basis for the microscopic theory and a comparison of theory and experiment for several phenomena are given. Mentioned are: (1) specific heat and critical fields; (2) tunneling and ultrasonic attenuation; (3) nuclear spin relaxation; (4) coherence effects;(5) penetration depths; (6) surface impedance; (7) infrared transmission and absorption; (8) Hall effect; (9) boundary energies;(10) critical fields and currents in small specimens;(11) thermal conductivity; (12) superconducting alloys and compounds;(13) Knight shift; (14) pressure and strain effects; and (15) isotope effect. R.W.H.

N65-32490 Bristol Univ. (England). H. H. Wills Physics Lab.
ELECTRICAL CONDUCTIVITY
R. G. Chambers *In* AGARD Advan. in Mater. Res. in the NATO Nations 1963 p 293–302 refs (See N65-32475 21-26) CFSTI: HC $8.35/MF $2.50

The information needed to calculate the transport properties is summarized, and two recent and very different calculations on the alkalis are discussed and compared. Neither is really satisfactory, but a more exact treatment would be extremely laborious, and of doubtful value at present. In particular, the calculated conductivities need to be corrected for electron–electron correlation effects; the size of these corrections is at present uncertain, but they may be considerable. The transition metals present special difficulties, and here the theory is in a still less satisfactory state. Results obtained by the usual Boltzmann equation methods have recently been reinvestigated and generally confirmed by the more rigorous density-matrix techniques. These techniques should be particularly valuable in dealing with correlation effects, and work on these lines is just beginning. Author

N65-32491 Technische Hochschule Stuttgart (West Germany).
ELECTRICAL AND THERMAL CONDUCTIVITY OF METALS AND INSULATORS
Helmut Bross *In* AGARD Advan. in Mater. Res. in the NATO Nations 1963 p 303-322 refs (See N65-32475 21-26) CFSTI: HC $8.35/MF $2.50

Reports on some recent work in the theory of electronic transport phenomena, in which is taken account of the anisotropic frequency spectra as determined by use of lattice dynamics is discussed. It is shown that the anomalous sign of the thermo-electric power of the noble metals may be explained in terms of deviations from the assumption of quasi-free electrons and by anisotropy of the frequency spectra. The theory of thermal conductivity by lattice waves (phonons) is considered. A method of calculating quantitatively the change of the thermal resistance due to scattering of phonons by lattice defects is developed. Since the conditions of compatibility are violated for most lattice defects, nonlinear elasticity theory is generalized for a medium with internal strains. For solving the Boltzmann equation, which is not possible by the use of the concept of relaxation times, a variational method is used which does not require special assumptions for the trial functions. The change of the thermal resistance due to screw dislocations in Cu is found to agree better with the experimental value than the value calculated with Klemens' theory. Author

N65-32492 Paris Univ., Orsay (France).
SEMICONDUCTORS [SEMICONDUCTEURS]
P. Aigrain *In* AGARD Advan. In Mater. Res. in the NATO Nations 1963 p 323–328 In FRENCH (See N65-32475 21-26) CFSTI: HC $8.35/MF $2.50

A brief review of the physical and electrical properties of semiconductors, the development of semiconductor technology, and the uses of semiconductors in materials engineering, is presented. Transl. by J.M.D.

N65-32493 Grenoble Univ. (France).
THE ACTUAL STATE OF OUR KNOWLEDGE CONCERNING FERROMAGNETISM AND ANTIFERROMAGNETISM [L'ETAT REEL DES NOS CONNAISSANCES CONCERNANT FERROMAGNETISME ET ANTIFERROMAGNETISME]
Louis Neel *In* AGARD Advan. In Mater. Res. in the NATO Nations 1963 p 329–347 In FRENCH (See N65-32475 21-26) CFSTI: HC $8.35/MF $2.50

Current state-of-the-art and historical development in the areas of ferromagnetism and antiferromagnetism are discussed. Particular emphasis is on recent experiments in magnetic interactions among atoms and in hyperfrequency, and on the presently limited range of applications. Transl. by J.M.D.

N65-32606 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN PROPERTIES OF THIN INDIUM PHOSPHIDE LAYERS
Ya. A. Ugay, Ye. M. Averbakh, R. L. Fogel'son, and V. A. Gol'dfarb *In its* News of the Acad. of Sci. of the USSR Phys. Ser. p 1–4 refs (See N65-32605 21-25)

Chemical and physical properties of thin indium phosphide layers prepared by separate deposition of indium and phosphorus were studied. Presented is an appraisal of the method used in the preparation of the semiconductor compound, data on the dependence of electrical conductivity on temperatures in the range 20 to 500° C, and results of determinations of the long-wave limit of primary absorption on the prepared films. Transmission diffraction patterns and calculations of interplaner spacing verified the proficiency of the selected method for preparing thin layers of indium phosphide. Electrical conductivity data for two films, one of which was subjected to annealing in a vacuum at 250° C, was in good agreement in the high-temperature region. The width of the forbidden band in this temperature range was 1.42-eV. The width of the forbidden band with respect to absorption was $\Delta E_{293° K}$ = 1.27-eV.

S.C.W.

N65-32607 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CERTAIN ELECTRICAL AND GALVANOMAGNETIC PROPERTIES OF INDIUM ARSENIDE FILMS

V. A. Kas'yan *In its* News of the Acad. of Sci. of the USSR, Phys. Ser. p 5–8 refs (See N65-32605 21-25)

Electrical and galvanomagnetic properties of indium arsenide films obtained in a vacuum by the simultaneous vaporization of the starting components, were studied. Analyzed were film samples measuring 20 × 80-mm with a thickness varying smoothly along the dielectric substrate from 0.5 to 5-μ. Presented are data on the dependence of electrical conductivity and the Hall effect on film thickness and temperature in the range 130- to 650°-K. It was found that as the layer thickness increases from 0.5- to 5-μ, the dimensions of the crystals composing it increase from tenths of microns to several microns. The growth of crystalline grains leads to a decrease in the number of contact resistances, their effect decreases, and electrical conductivity increases. Up to T≈300 to 400° -K, electrical conductivity and the Hall coefficient depended weakly on temperature and at higher temperatures a region of combined conductivity was observed.

S.C.W.

N65-32608 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATING CERTAIN PHYSICAL PROPERTIES OF $CuSbS_2$ AND $CuSbSe_2$ SINGLE CRYSTALS

G. B. Abdullayev, R. Kh. Nani, Ya. N. Nasirov, and T. G. Osmanov *In its* News of the Acad. of Sci. of the USSR, Phys. Ser. 9–17 refs (See N65-32605 21-25)

Electrical conductivity, thermal conductivity, and thermal emf properties of $CuSbS_2$ and $CuSbSe_2$ polycrystalline samples and monocrystals were studied. Presented is an appraisal of the methods used in the synthesis of polycrystalline samples, and the preparation of single crystals of these compounds. Electrical conductivity for Cu–SbS_2 and Cu–$SbSe_2$ samples increased with temperature from 0.08- and 3.2-ohm^{-1} cm^{-1} at room temperature to 7- and 6.3-ohm^{-1} cm^{-1}, thermal emf decreased from 950- and 400-μV degree^{-1} at room temperature to 120- and 110-μV degree^{-1}, respectively. The dependence of electrical conductivity of single crystals of both compounds revealed an increase with temperature. In $CuSbSe_2$ the temperature dependence of conductivity had a metallic characteristic. Thermal conductivity of single crystals of both compounds in the range 80- to 300° -K at first decreased with temperature then increased having a minimum at 273- and 300° -K, respectively. Included are data on the dependence of current-carrier mobility on temperature for single and polycrystalline samples.

S.C.W.

N65-32742# Sylvania Electric Products, Inc., Woburn, Mass. Semiconductor Div.

DEVELOPMENT OF EPITAXIAL TECHNOLOGY FOR MICROELECTRONICS AND LARGE AREA DEVICE APPLICATION Quarterly Report, 1 Mar.–31 May 1965

P. Wang, R. Yee, and J. Eknaian 1 Jun. 1961 32 p (Contract NObsr-85431) (QR-12; AD-617543)

Work has essentially been completed on PNPN light-sensitive matrices made by both oxide-masked epitaxy and by epitaxy-diffusion techniques. Matrices fabricated with the latter technique are considerably more sensitive, turning on with only 0.2 foot-candles of incident illumination. (This sensitivity can be reduced with a subsequent improvement in uniformity from unit to unit.) Measurement methods are described, and light sensitivity results are given for both types of units. A search for the best method for making matched NPN-PNP transistor pairs has begun. A discussion of the pros and cons of all known methods is presented, with the conclusion that the beam lead process offers the most practical way to achieve such devices. A slowing down of this portion of the program will result to allow related company-funded beam lead developments to catch up with device fabrication developments under the contract.

Author

N65-32800# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

PATCH EFFECTS AND AVERAGE WORK FUNCTIONS OF POLYCRYSTALLINE THERMIONIC EMITTERS [LES EFFETS DES TACHES (OU GRAINS) ET LE TRAVAIL DE SORTIE MOYEN D'UN EMETTEUR POLYCRISTALLIN]

Bernard Devin and Nguyen Xuan Phuc Jul. 1964 31 p refs In FRENCH (CEA-R-2519) CFSTI: HC $2.00/MF $0.50

Electron emission and transfer between electrodes in a cesium thermionic converter is investigated theoretically. With respect to polycrystalline refractory metals, the patch effect on both bare and cesium-coated emitters is analyzed. In the case of monocrystalline refractory metals, the analysis concerns the anisotropy of work functions with crystalline structures having surfaces either ideally perfect or cesium-coated.

Transl. by J.M.D.

N65-32821# Joint Publications Research Service, Washington, D. C.

NONLINEAR POLARIZATION OF A WEAKLY ABSORBING DISPERSIVE MEDIUM

F. A. Akhmanov and R. V. Khoklov 8 Sep. 1965 57 p Transl. into ENGLISH of Chapter One of the Book "Probl. Nelineynoy Optiki" Moscow, 1964 p 25–78 (JPRS-31910; TT-65-32404) CFSTI: $3.00

Properties of nonlinear polarization tensors are analysed in the framework of quantum microtheory. The particular tensors studied are those which determine the form of the nonlinear relationship between the electric induction vector and the macroscopic field of a weakly absorbing dispersive medium. Also, the statistical theory of nonlinear polarization is presented, based on both classical and quantum models.

J.M.D.

N65-33130*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.

AN INVESTIGATION OF THIN-FILM GOLD STRUCTURES ON CdS

Anthony A. Aponick May 1965 51 p refs
(Grant NsG-496; MIT Proj. DSR 9948)
(NASA-CR-64626; ESL-R-237) CFSTI: HC $3.00/MF $0.50
CSCL 20L

Previous electron microscopic investigations of the structures of gold thin-films deposited on CdS surfaces have shown that these structures can be made electrically discontinuous with thermal treatments. This phenomenon is shown to exist for gold surface mass densities up to 30 $\mu g/cm^2$. An investigation is made of the possibility that high electrostatic fields can be used to exert sufficient force on the discontinuous gold grains during annealing to cause the formation of "bridges" between them. It is shown that this procedure is not useful for the formation of grid-like structures. A theoretical treatment is presented which shows that annealing phenomena can be explained with an atomic gold gas model. The theory predicts that "solid-layer" structures are not stable at high substrate temperatures. A means of fabricating grid-like structures with 40-50% open area and sheet resistances of 12-50 Ω/sq. is described in detail. The method of production is found to be a consequence of the gas-model. Author

N65-33240# Carnegie Inst. of Tech., Pittsburgh, Pa. Metals Research Lab.
THE DETERMINATION OF ELECTRONIC PROPERTIES OF MOLTEN SULFIDES BY ELECTRICAL AND MAGNETIC MEASUREMENTS Quarterly Progress Report, 1 Sep.–30 Nov. 1964
G. Derge 26 Jan. 1965 4 p
(Contract Nonr-760(22))
(AD-462036)

Zero values for Hall coefficients were obtained for S-rich Ni-S using both the original cell and a cell that was modified so that the leads of the molten material ran from the normal Hall probe positions to one end of the cell where contact was made with the tungsten probes in a uniform temperature zone. It is concluded that these zero values indicate that the Ettinghausen effect in the molten material must be negligible in contrast to results obtained in the Cu-S system. M.W.R.

N65-33242# Massachusetts Inst. of Tech., Cambridge. Energy Conversion and Semiconductor Lab.
THERMOELECTRIC PROCESSES AND MATERIALS Progress Report, Jan. 1, 1963–Jul. 1, 1964
1 Jul. 1964 15 p refs
(Contract Nonr-1841(51))
(PR-6; AD-463889)

Investigations of basic properties of semiconductor materials important in energy conversion applications, and physical mechanisms involved in energy conversion are presented. A summary of completed investigations is included on mechanical energy flow in crystal lattices, attenuating wave analysis of heat flow in crystal lattices, relativistic effects in lead telluride, calculation of electronic properties of strained lead telluride, and temperature dependence of the electron voltaic effect in silicon P-N junctions. Current research on energy bands and properties of lead telluride, and heat flow and attenuating wave analysis is discussed. Also included are discussions of discontinued investigations on energy bands in Bi_2Te_3 and the effects of strain in PbTe. R.N.A.

N65-33248# Radio Corp. of America, Princeton, N. J. Electronic Components and Devices.
LOW TEMPERATURE INFRARED PHOTOCONDUCTORS Semiannual Report, 1 Dec. 1964–31 May 1965
M. L. Schultz, W. E. Harty, and C. D. Rowley 25 Jun. 1965 42 p refs
(Contract Nonr-2225(00))
(AD-617325)

An experimental study designed to explore the possibility of utilizing extrinsic impact ionization as a means of increasing the carrier generation rate for a given photon absorption rate, is reported. Measurements were made upon copper doped- and zinc doped-germanium, and their rates of impact ionization compared in an effort to determine the limitation imposed by optical phonon generation. Included are derivations of gain equations, and results of dc bias voltage, pulse bias voltage, dc current-voltage, noise, and photosignal analyses. S.C.W.

N65-33286*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
AN ELECTRON MICROSCOPIC INVESTIGATION OF CdS THIN-FILM SURFACES
Anthony A. Aponick Mar. 1965 38 p refs
(Grant NsG-496)
(NASA-CR-64818; ESL-R-229) CFSTI: HC $2.00/MF $0.50
CSCL 20B

The vacuum-deposited CdS thin-film surface is studied in detail by especially developed electron microscope techniques. The structure of the surface is found to vary with substrate temperature and deposition rate. The surface is then coated with small amounts of gold at various deposition substrate temperatures, and found to present an extremely uniform and high density distribution of active nucleation sites. Thermal treatments are described which prevent these nucleation sites from forming a completely continuous gold film at high surface mass densities. Author

N65-33299# Texas Instruments, Inc., Dallas.
ULTRASONIC INVESTIGATION OF THE MICROSTRUCTURE OF HARD SUPERCONDUCTORS Technical Summary Report, 17 Jan.–30 Apr. 1965
Lewis T. Claiborne and Norman G. Einspruch Wright-Patterson, AFB, Ohio, AF Mater. Lab., Aug. 1965 76 p refs
(Contract AF 33(615)-1633)
(TI-08-65-85; AFML-TR-254; AD-469682)

This report presents results of an ultrasonic study of superconducting Nb-Zr alloys. An attempt has been made to relate the temperature dependence of compressional wave attenuation and the magnetic field dependence of both compressional and shear wave attenuation to the microstructure of the alloys. The temperature dependence of compressional wave attenuation in the absence of magnetic field below the transition temperature exhibits a series of absorption peaks which have been explained in terms of an interaction with the electron gas by means of density modulation of the electronic free energy. This interaction is strongly dependent on the strain and defect content of the sample and results in one or more sets of frequency-dependent peaks which are harmonic in a temperature function $f(T) = [1 - aT^2 + bT^4]^{1/2}$. The absorption effects have been traced from one alloy to another and have been studied for various states of anneal and deformation. Simultaneous measurements have been made of ultrasonic attenuation, sample temperature and magnetic moment for isothermal and adiabatic magnetization. Author

N65-33316# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CHARACTERISTICS OF A PHTHALOCYANINE RECTIFIER

C. Hamann 22 Jul. 1965 8 p refs Transl. into ENGLISH from Phys. Status Solidi (Germany), vol. 4, no. 3, 1964 p 97–100
(FTD-TT-65-374-/1+2+4; AD-467675)

A mixing crylstal of metal-free Pc (polycrystalline phthalocyanine) and Cu-Pc (1:1 weight percent) displayed the following semi-conductor characteristics: specific resistance of ρ 300° K = 4.8 X $10^{6}\Omega$cm; thermal activation-energy of the charge carrier E = 0.66 eV, with Seebeck coefficient α = +580 μV/degree. Pressed phthalocyanine semiconductors showed p-n junction effects with metal surface contacts. Ohmic contacts were obtained with platinum and gold, as well as with silver surfaces. A non-linear symmetrical voltage characteristic was observed by application of two similar metal tips; a forward direction was always present when the metal tip was negative in comparison to the surface contact. The ratio of the value of the current in the forward direction to the current in the direction of the p-n junction increased for metal tips in the following series: gold, platinum, silver, Cr-Ni, Ta, Cu, Mn, Mo, Fe, W, brass, and aluminum from 1 to several 1000.
G.G.

N65-33441# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
THE ROLE OF DIFFUSION MEASUREMENTS IN THE STUDY OF CRYSTAL LATTICE DEFECTS
G. V. Kidson Jul. 1965 24 p refs Presented at the IAEA-Symp. on Thermodyn., with Emphasis on Nucl. Mater. and Atomic Transport in Solids, Vienna, 22–27 Jul. 1965
(AECL-2309) CFSTI: HC $1.00/MF $0.50

This paper reviews some recent diffusion studies conducted at C.R.N.L. that provide, in addition to data of interest in nuclear technology, a means of gaining some insight into the more fundamental nature of the lattice defects occurring in the materials. The systems discussed are (i) self diffusion in the high temperature phase of pure zirconium (ii) solute diffusion in lead and (iii) interdiffusion of aluminum and zirconium. Evidence is given to suggest that diffusion occurs either through a dense dislocation network produced as a result of a martensitic phase transformation, or, alternatively, by excess vacancies introduced into the crystal by impurities. In (ii) the extraordinarily rapid diffusion of noble metal solutes in high purity lead single crystals will be discussed in terms of the state of solution of the solute atoms. In (iii) the formation and rapid growth of a single intermetallic compound $ZrAl_3$ in the duffusion zone formed between pure zirconium and pure aluminum is described and the diffusion mechanism is interpreted in terms of the structure of the compound lattice. The results indicate that $ZrAl_3$ forms a defect lattice, leading to the relatively rapid migration of aluminum atoms. Author

N65-33506*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
RADIATION EFFECTS ON SILICON First Quarterly Progress Report, 1 Jun. –31 Aug. 1964
D. P. Snowden and V. A. J. van Lint 10 Sep. 1964 15 p refs (Contract NAS7-289)
(NASA-CR-64847; GACD-5678) CFSTI: HC $1.00/MF $0.50

Investigations are continuing on radiations effects in silicon. Irradiated samples of n-type and p-type silicon were studied by electron spin resonance techniques. The technique for measuring lifetime as a function of injection level was refined and applied to a sample of p-type silicon. The temperature dependence of the lifetime was measured in another sample of p-type silicon by a microwave relectivity technique. R.N.A.

N65-33513# Texas Instruments, Inc., Dallas.
RESEARCH AND INVESTIGATION OF GALLIUM ARSENIDE–INDIUM ARSENIDE ALLOY SYSTEMS Third Interim Engineering Report, 1 Nov. 1964–31 Jan. 1965
R. W. Haisty Feb. 1965 42 p refs *Its* Rept.-08-65-31
(Contract AF 33(615)-1272)
(AFAL-TR-65; AD-482882)

Epitaxial (Ga,In)As alloys were prepared on n+ and semi-insulating substrates. These were used for diffusion, alloying and associated device fabrication studies, optical studies, e.g., visible reflectivity and infrared transmission, and electrical evaluations, in particular the effect of annealing on electron mobility. Reflectivity (in the range 0.4 to 0.6 micron) was developed as a routine method for estimating alloy composition. This techhique is rapid and gives good accuracy, although preparing the sample surface requires care. Chemically etched surfaces, however, give very reproducible results consistent with those obtained from other analytical techniques, e.g., infrared transmission and X-ray diffraction. The first attempt to dope (Ga,In)As using diethyl zinc produced a thin p-type layer. Several later runs using lower diethyl zinc flow rates are being evaluated. Author

N65-33545*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
BETHE-PEIERLS-WEISS APPROXIMATION AND A MODEL FOR FERROMAGNETIC THIN FILMS
Gale Fair Washington, NASA, Sep. 1965 35 p refs
(NASA-TN-D-2979) CFSTI: HC $2.00/MF $0.50 CSCL 20L

The cluster approximation developed by P. R. Weiss to treat the problem of the Heisenberg ferromagnet is used to calculate the ferromagnetic properties of a two-layer rectangular lattice, a simple cubic lattice, and a body-centered cubic lattice, for spin 1/2 atoms. The two-layer rectangular lattice is considered as a model for a simple cubic ferromagnetic thin film, and the results are compared with the properties of a complete simple cubic lattice. The results obtained indicate that such a two-layer lattice shows ferromagnetic behavior, with a Curie temperature about two-thirds that of the simple cubic lattice. The magnetization, internal field, energy, specific heat, and paramagnetic susceptibility are calculated and compared for the three lattices. One feature that appears in this calculation for the two-layer lattice, as previously obtained for the simple cubic case, is the occurence of an "anti-Curie" temperature; a second, lower, temperature at which the spontaneous magnetization vanishes. Author

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N65-32868# Naval Research Lab., Washington, D. C.
EXPLOSION HAZARDS OF MIXED HYDRAZINES FUEL
H. E. Moran, Jr., J. C. Burnett, and E. I. Smith, May 1965 23 p
(NRL-MR-1615; AD-617531)

MHF type fuels were examined for their tendency to explode when heated or burned. Heating tests were made in glass containers. Burning tests were made in glass, stainless steel, and mild steel containers to evaluate the effects of these

materials in contact with the fuel. Foreign materials (water, carbon, cotton, hydrocarbon oils, and painted surfaces) also were placed in the burning fuel in some tests. Records of the fuel temperature during the tests were obtained. The burning environment was varied by externally supplied heating and cooling, and by wind blowing across the fuel. Heating the fuels (without burning) regularly produced explosions ranging from light to very strong. The temperature records showed that the nonburning fuels reached a temperature in the vicinity of 300° C before exploding. Burning fuels, on the other hand, generally changed to auto-oxidation (flare burning) at temperatures between 100 and 200° C and apparently were consumed before reaching the explosion temperature. Author

N65-32934# Shell Development Co., Emeryville, Calif.
FUNDAMENTAL RESEARCH ON ADVANCED OXIDIZERS Quarterly Technical Report No. 9, Dec. 1964–Feb. 1965
R. P. Nielsen, A. M. Benson, F. S. Mortimer, J. N. Wilson, and R. M. Curtis [1965] 47 p refs
(Contract DA-31-124-ARO(D)-54; ARPA Order 402)
(S-13956; AD-464969)

Effects of large doses of high energy ionizing radiation on NF_3, OF_2, BF_3, N_2F_4, and various perhalogenated methanes were surveyed. Mass spectrometric studies suggest formation of B_2F_2, BNF_2, $N_2F^+BF_4^-$, NO_4^-, F_2SO_4, $FOSF_5$, CLF_3, ClF_2Cl, ClF_2CF_3, and $ClFClCF_3$. An experiment to determine whether $\cdot NF_2$ radicals can be distilled and observed by heating N_2F_4 to 475° K at low pressure, then freezing the products at 77° K, showed no abnormal amount of NF_2^+ in the mass spectra. Infrared spectroscopic evidence was obtained for the formation of ClF as a product of the pyrolysis of ClF_3, and a self-consistent field molecular orbital method for correlating energies of formation and predicting charge distributions is described. The magnitude of the London potential, and the theoretical form of the repulsive potential were studied, and theoretical treatments and experimental data reviewed. Calculations were made with the electrostatic model for polar diatomic molecules, for comparison with the ionic crystals model, and it was concluded that the computed polarizability is lower then the experimental value. M.G.J.

N65-32947# Aerojet-General Corp., Downey, Calif. Research Div.
LARGE SOLID-PROPELLANT BOOSTERS EXPLOSIVE HAZARDS STUDY PROGRAM, PROJECT SOPHY Status Report No. 8, 1–31 Jan. 1965
O. R. Irwin, P. K. Salzman, and G. L. Roark 22 Feb. 1965 46 p refs
(Contract AF 04(611)-9945)
(Rept.-0866-01(08)MP; AD-465027)

Continued research conducted under a program designed to study explosive hazards of large solid-propellant boosters, is reported. Focused on are studies in two major areas of technical inquiry: critical diameter and critical geometry. Presented are results of instrumented critical diameter tests which were conducted using an RDX-adulterated propellant containing 6.75-wt% RDX; an appraisal of techniques being used to monitor the void content of RDX-adulterated propellant; and a discussion of proposed changes under the theoretical program. A sample from Batch-7 was examined for variations in density and RDX concentration, and one of three approaches to improving the material investigated. No critical geometry tests were performed. Discussed are certain difficulties relating to RDX composition and density gradients in Batch-7 material. Theoretical studies focused on a re-evaluation of a model for predicting the effects of composition, particle size, and density, on detonation characteristics. S.C.W.

N65-32949# United Research Services, Burlingame, Calif.
STUDY OF LIQUID PROPELLANT BLAST HAZARDS Quarterly Technical Documentary Report No. 6, 19 Dec. 1964–19 Mar. 1965
A. B. Willoughby, C. Wilton, and J. Mansfield Edwards AFB, Calif., AF Rocket Propulsion Lab., 8 Apr. 1965 91 p refs
(Contracts AF 04(611)-9558; AF 04(611)-10739)
(URS-652-1; AD-464970)

Progress is reported on a program to develop a philosophy for predicting credible damage potential which may be expected from the accidental explosion of liquid propellants during launch or test operations of missiles or space vehicles. During this report period emphasis was placed on a preliminary analysis of results from initial 200 lb cryogenic tests, the design of the experimental arrangement and test tankage for the second high velocity impact test series, the design of a method for implementing the selected S-IV failure mode, and consideration of the design of a small scale charge geometry study. R.N.A.

N65-33139*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AN EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF COMBUSTION ON THE MIXING OF HIGHLY REACTIVE LIQUID PROPELLANTS
Bruce H. Johnson 15 Jul. 1965 25 p refs
(Contract NAS7-100)
(NASA-CR-64616; JPL-TR-32-689) CFSTI: HC $1.00/MF $0.50 CSCL 21I

The effects of combustion on the liquid-phase mixing of several storable liquid bipropellants were investigated. It was found that combustion effects were severe when nitrogen tetroxide was used as the oxidizer with various storable fuels, including hydrazine, unsymmetrical dimethylhydrazine, and monomethylhydrazine. Other combinations tested were found to be less affected by the combustion process. Several attempts were made to induce propellant mixing by mechanical means, and the effects of chemical inhibitors on the mixing process were investigated. None of the mechanical and chemical techniques studied influenced the prereaction mixing of the propellants to an appreciable extent. Author

N65-33262*# National Aeronautics and Space Administration. Lewis Reserch Center, Cleveland, Ohio.
EXPERIMENTAL PERFORMANCE OF GASEOUS HYDROGEN AND LIQUID OXYGEN IN UNCOOLED 20,000-POUND-THRUST ROCKET ENGINES
Edward A. Rothenberg, Franklin J. Kutina, Jr., and George R. Kinney Washington, NASA, Mar. 1959 23 p refs
(NASA-MEMO-4-8-59E) CFSTI: HC $1.00/MF $0.50 CSCL 21 I (Declassified

Experiments were conducted with gaseous hydrogen and liquid oxygen in uncooled rocket chambers of 20000-pound thrust at a chamber pressure of 300 pounds per square inch absolute. A showerhead injector was used. Data were obtained with from 11 to 24 percent hydrogen in the propellant and with three combustion-chamber lengths. Specific impulse ranged from 94 to 98 percent of theoretical for equilibrium expansion, highest values occurring at the highest percent fuel mixtures. Maximum specific impulse was 350 pound-seconds per pound at 23.5 percent hydrogen. Performance was unaffected by changes in combustion-chamber length which varied the distance from the injector to the throat from 17.8 to 78 inches. Author

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N65-32442* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ADVANCED LIQUID PROPULSION SYSTEMS
R. N. Porter, D. D. Evans, W. H. Tyler, W. F. Mac Glashan, and O. F. Keller *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p162-171 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

Progress is reported on the study of the reactions between nitrogen tetroxide and hydrazine; on the firing tests of several ablative thrust chambers; on a method for locating pinholes in metal foils; on high and low temperature tests of a tank and expulsion diaphragm assembly; and of the metallographic examination of an aluminum propellant tank which was subjected to long-term storage test with hydrazine. The data obtained on the study of nitrogen tetroxide and hydrazine are consistent with the fact that nitrogen tetroxide–hydrazine impinging jets are subject to disruption by the rapid reaction occurring at the interface between the two propellants. The principle factors which cause this phenomenon are the rapid reaction rate and the immiscibility of the two reactants. Although these factors are closely related, it appears that miscibility is a major factor. Photographic studies showing the dropwise addition of N_2O_4 to N_2H_4 show that the two materials are completely immiscible. Test results also have shown that tanks of aluminum alloy are essentially unaffected by long-term contact with anhydrous hydrazine from 30° to 100° F.
E.E.B.

N65-32603# California Inst. of Tech., Pasadena. Firestone Flight Sciences Lab.
SOLID ROCKET STRUCTURAL INTEGRITY ABSTRACTS, VOLUME 2, NO. 3
R. A. Westmann, ed. Jul. 1965 114 p refs
(Contract AF 04(611)-9572)
(AD-619247)

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N65-33306# Picatinny Arsenal, Dover, N. J. Feltman Research Labs.
TREATMENT OF PROPELLANT MECHANICAL PROPERTY DATA BY REACTION RATE ANALYSIS
Elise Mc Abee and David W. Levi Aug. 1965 26 p refs
(PA-JR-3258; AD-468321)

By application of reaction rate analysis methods to available data for four propellant formulations obtained over a range of temperatures, if was found that a reasonable prediction of the mechanical properties could be made, at least for the static case. This method of analysis was applied to data for the propellant formulations OGK, ARP, T-16, and X-8. Since isothermal data had been obtained at only one temperature, the analysis could not be extended to relate mechanical performance to molecular structure. Reaction rate analysis does not seem completely applicable to high rate data since for the propellants studied the process appears to be too rapid for the individual elements to respond to the loading process leading to failure. However, the time to failure is a function of the reciprocal of the absolute temperature and from this relationship a prediction of failure stress may be made. Author

N65-33335# Picatinny Arsenal, Dover, N. J. Propellants Lab.
A STUDY OF COMBUSTION CATALYSIS AND PROPELLANT DECOMPOSITION BY MASS SPECTROMETRY
R. P. Baumann and J. P. Picard Jul. 1965 24 p refs
(PA-TM-1685; AD-468333)

A research project designed to gain an understanding of the mechanism of action of ballistic modifiers in nitrocellulose based propellants was carried out. A study was undertaken to investigate the feasibility of using mass spectrometry to follow the reactions occurring on the decomposing surface of solid propellant grains. A special low pressure arc-image strand burner was designed and fabricated for monitoring on the mass spectrometer. The spectrometer is a 60° sector fast scan machine allowing 1000 sweeps/second with an accuracy on simple mixtures with interfering peaks between 0.05 and 1.0%. The equipment worked extremely well and can be considered applicable to studying a wide range of solid propellants. A number of unstable species and free radicals were found; particularly NO_3, CH_3CO^*, and CHO^*. These species were not only detected during and after "burning" but also were detected prior to any visual indication of decompositl n. Preliminary data indicates that lead catalysts increase the rate of oxidation-reduction reaction between, probably, CH_3CO^* and NO_3.
Author

N65-33419# Aerojet-General Corp., Sacramento, Calif.
FEASIBILITY OF A TRIPROPELLANT FEED SYSTEM Informal Monthly Contract Status Report No. 9, 1 Dec. 1963–31 Aug. 1964
9 Sep. 1964 11 p
(Contract AF 04(611)-9571)
(Rept.-M-9; AD-461023)

In a study of the feasibility of a tripropellant feed system, fiscal status of the separate projects is reviewed. Also, the preparation of gel mixes, and testing activities involving the mixer and cold flow system in connection with liquid oxygen are discussed briefly. J.M.D.

N65-32604 Lockheed Propulsion Co., Redlands, Calif.
PROPELLANT GRAIN STRUCTURAL INTEGRITY PROBLEMS: ENGINEERING STATUS
J. Edmund Fitzgerald *In* Calif. Inst. of Tech. Solid Rocket Structural Integrity Abstracts, Vol. 2, No. 3 Jul. 1965 p 1–44 refs (See N65-32603 21-28)

Use in the solid propellant industry of established methods of linear viscoelastic stress analysis in static and quasi-static problems is described. Topics covered are the use of materials with memory for solid propellants, thermo-mechanical coupling effects in solid propellants, the uncoupled thermo-mechanical problem, characterization of propellants by a general reduced time for uniform cooling, the problem of intrinsic material or physical nonlinearity for highly loaded solid propellants, and the principle of equipresence for determination of the proper nonlinear formulation for strongly coupled thermo-mechanical nonlinear problems. J.M.D.

N65-32758*# Rocketdyne, Canoga Park, Calif.
INVESTIGATION OF COOLING PROBLEMS AT HIGH CHAMBER PRESSURE Final Report, 1 Jul. 1963–31 Mar. 1965
W. S. Hines, F. W. Hoehn, W. S. Miller, A. S. Okuda, J. D. Seader et al Jul. 1965 440 p refs
(Contract NAS8-4011)
(NASA-CR-64530; R-6199) CFSTI: HC $7.40/MF $2.50 CSCL 21H

Analytical and experimental results are presented of a continuation of the investigation to develop the engineering data and technology required to design cooling systems for liquid propellant rocket engines operating at chamber pressures from 1500 to 5000 psia and thrust levels up to 6 million pounds using liquid oxygen/hydrocarbon and liquid oxygen/liquid hydrogen as propellants. Author

N65-32877*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
BASE PRESSURES AND CONVECTIVE HEAT-TRANSFER COEFFICIENTS FOR CLUSTERED SONIC NOZZLES WITH EMPHASIS ON CHOKED EXHAUST BACKFLOW
John P. Weidner and James M. Cubbage Sep. 1965 47 p refs
(NASA-TN-D-2929) CFSTI: HC $2.00/MF $0.50 CSCL 21H

A base heating investigation has been conducted to determine local heat-transfer coefficients and pressures due to backflowing exhaust gases from clusters of three and four sonic nozzles. This investigation was concerned with the condition for which backflowing exhaust gases become confined within the nozzle cluster and choke at the minimum area between adjacent nozzles. The models simulated nozzle arrangements of typical launch vehicles, and data were obtained over a range of nozzle spacings, nozzle extensions beyond the base plate, and nozzle total pressures. It was found that the highest pressures and heat-transfer coefficients generally occurred at the base center, with a second but smaller rise in heat-transfer coefficient occurring between adjacent nozzles. Base pressure and heat-transfer coefficients were reduced by increasing either the nozzle spacing or the nozzle extension, and the highest values were observed for the four-nozzle models. A direct proportionality was found between the pressures and heat-transfer coefficients at the base center. At a common base-center pressure, less heat transfer occurs for the larger nozzle spacings and for the smaller nozzle extensions. Author

N65-32901# United Technology Center, Sunnyvale, Calif.
XSR 57-UT-1 MOTOR TESTING—PFRT PHASE Test Plan
2 Feb. 1965 14 p
(Contract AF 04(695)-588)
(UTC-2100-TP6, Rev. A; AD-464982)

A test plan, covering preliminary flight rating tests (PFRT) of the XSR 57-UT-1 rocket motor, was devised to provide data for flight configuration acceptance. The series consists of one firing under 180 rpm spin conditions, and five firings at simulated altitude and spin rates of 0 to 200 rpm; and a 1000-mile secondary road test on three motors. Objectives are listed for ignition delay, ballistic performance, external motor case temperature, and transportation tests; and conditions are defined for temperature cycle, temperature conditioning, and secondary road transportation tests. Motor configurations are depicted, and details for test documentation are included. M.G.J.

N65-32931# Air Force Systems Command, Edwards AFB, Calif. Rocket Propulsion Lab.
EVALUATION OF MECHANICAL THROTTLING AT SIMULATED ALTITUDE Technical Memorandum, 23 Jan.–21 May 1964
Dwight U. Phillips and Kaye O. Rimer Aug. 1964 33 p
(RPL-TM-64-30; AD-465584)

Presented are results of rocket engine throttling tests conducted under simulated altitude conditions with a throttling injector and engine hardware. Throttling was demonstrated over a chamber pressure range of 4.8 to 108 psia. The objective of this program was to determine the performance of the pintle-throttled injector at simulated altitude conditions. Although data was limited by premature failure of a thrust chamber nozzle, the following conclusions were reached: (1) maintaining performance and mixture ratio control in mechanically deep throttled rocket engines requires extremely close tolerance and very fine calibration adjustment, and (2) these requirements could be reduced in magnitude, or eliminated, if fixed area throttling concepts were employed. Further testing is recommended to substantiate these conclusions. S.C.W.

N65-33129*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AN EXPERIMENTAL CORRELATION OF THE NONREACTIVE PROPERTIES OF INJECTION SCHEMES AND COMBUSTION EFFECTS IN A LIQUID-PROPELLANT ROCKET ENGINE. PART I: THE APPLICATION OF NONREACTIVE-SPRAY PROPERTIES TO ROCKET-MOTOR INJECTOR DESIGN
Jack H. Rupe 15 Jul. 1965 60 p refs
(Contract NAS7-100)
(NASA-CR-64635; JPL-TR-32-255) CFSTI: HC $3.00/MF $0.50 CSCL 21H

The properties of the sprays produced by a pair of unlike impinging streams of nonreactive fluids were utilized as the design basis for a series of eight injectors having distinctively different specifications. Particular emphasis was placed on the use of available information and the development of new techniques, where required, to permit quantitative description of the mass and mixture-ratio distributions produced by each injection scheme. Methods of describing the mass-distribution model of an element are presented in detail, together with the properties of injector orifices, the jets they produce, and the combined flows provided by each injector. This information is being utilized as a basis for correlating injection schemes with combustion phenomena. Author

N65-33145*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ON THE EVOLUTION OF ADVANCED PROPULSION SYSTEMS FOR SPACECRAFT
Duane F. Dipprey, Jack H. Rupe, Richard N. Porter, and David D. Evans 15 Jul. 1965 39 p refs
(Contract NAS7-100)
(NASA-CR-64609; JPL-TR-32-735) CFSTI: HC $2.00/MF $0.50 CSCL 21H

The use of Earth-storable propellants in unmanned spacecraft propulsion systems for flights to the near planets and the Moon is investigated. Propulsion system requirements for such missions are outlined, and the major hazards of space flight are discussed. The basic concepts of a proposed spacecraft propulsion system are presented, and component design is shown to be integrated with these concepts so that solutions to individual component problems are compatible. Progress is summarized in the development of an engine, a gas generator, expulsion devices, regulators, and valves, all designed to meet the requirements of spacecraft propulsion systems burning Earth-storable propellants. A method for a priori injector design is shown, together with its application to a simple 10-element injector of the unlike-impinging-jet configuration. Nonreactive spray properties are used to obtain quantitative descriptions of mass and mixture-ratio distributions, and methods of obtaining the mass distribution model for an element are outlined. These techniques are being applied to the evaluation of combustion-chamber materials. High level, reproducible performance was obtained in pyrolytic graphite chambers. Without film cooling, erosion rates are an order of magnitude lower than those commonly encountered. R.R.D.

N65-33264*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LOW-PRESSURE PERFORMANCE OF A TUBULAR COMBUSTOR WITH GASEOUS HYDROGEN
Edmund R. Jonash, Arthur L. Smith, and Vincent F. Hlavin Washington, NACA, 9 May 1955 38 p refs
(NACA-RM-E54L30a) CFSTI: HC $2.00/MF $0.50 CSCL 21E
(Declassified)

An investigation was conducted to determine the combustion performance characteristics of gaseous hydrogen fuel in a single tubular turbojet combustor. The combustor was operated over a range of inlet-air pressures from 3.3 to 14.3 inches of mercury absolute. Reference velocities as high as 174 feet per second were investigated to pressures as low as 8.0 inches of mercury absolute; reference velocities at lower pressures were limited to lower values by the test facility. Limited comparison tests were conducted with gaseous propane fuel. Hydrogen fuel burned over very broad ranges of temperature rise at all pressure conditions investigated. No combustion instability or flame blow-out was observed. Combustion efficiencies in excess of 90 percent were maintained to pressures as low as 8.0 inches of mercury absolute with velocities as high as 174 feet per second. At pressures below 8.0 inches of mercury absolute, marked decreases in efficiency were observed.
Author

N65-33265*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INVESTIGATION OF AFTERBURNER COMBUSTION SCREECH AND METHODS OF ITS CONTROL AT HIGH COMBUSTOR PRESSURE LEVELS
Arthur M. Trout, William K. Koffel, and George R. Smolak Washington, NACA, 14 May 1956 48 p refs
(NACA-RM-E55K25) CFSTI: HC $2.00/MF $0.50 CSCL 21E
(Declassified)

Various methods for the control of afterburner combustion screech at afterburner-inlet total pressures of from 4000 to 6400 pounds per square foot absolute were investigated experimentally. In general, the range of afterburner fuel-air ratios in which screech occurred and the intensity of screech did not vary appreciably in the range of pressures covered. However, several configurations which had mild screech tendencies at the lower pressures were screech-free, or nearly so, at higher pressure levels. Screech was successfully eliminated over the range of pressures and fuel-air ratios investigated by several devices including a 20-inch length of corrugated louvered liner at the afterburner wall, a 7-inch perforated shroud around the outer ring of a 2-ring V-gutter flameholder, and a 2-ring V-gutter flameholder fabricated from perforated sheet metal. A 20-inch length of cylindrical liner spaced 5/8 inch from the afterburner wall and perforated with 3/16-inch-diameter holes on 1/2-inch centers did not entirely eliminate screech, but a 36-inch length of the same material did.
Author

N65-33288# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Porz (West Germany). Inst. für Luftstrahlantriebe.
SUCTION LOSSES OF SHARP-LIP AIR INTAKES [ANSAUGVERLUSTE BEI SCHARFLIPPIGEN LUFTEINLASSEN]
E. Söffker and A. Renner Jun. 1965 29 p refs In GERMAN; ENGLISH summary
(DLR-FB-65-26; DVL-386) CFSTI: HC $2.00/MF $0.50

A number of graphs are presented in this paper for calculating thrust and flight performance of air-breathing engines with sharp-lip supersonic intakes. These graphs permit estimation of the pressure recovery at static and low flight Mach number conditions. Consistent with two model configurations substituting the intake duct its total pressure ratio may be directly read as a function of the diffuser discharge Mach number. The parameter concerned is the area ratio of the diffuser. Comparison with values measured on various intakes indicates that the presented graphs appear to be well suited for prognostic purposes. For the case of limited additional air mass flow, the given data can also be considered as substantiated.
Author

N65-33295# Purdue Univ., Lafayette, Ind. School of Mechanical Engineering.
[PARAMETRIC STUDY OF ROCKET INSTABILITY] Final Report
M. J. Zucrow 17 Feb. 1965 9 p refs
(Grant AF-AFOSR-62-360)
(AD-614657)

The report is concerned with the determination of those dimensionless parameters that may be employed as criteria for predicting the stability of combustion in a thrust chamber. These dimensionless parameters are related to physical and chemical variables which are available to the design engineer. Both analytical and experimental work have been done to enable the prediction of combustion pressure oscillations and, therefore, avoid them in actual rocket engine design.
Author

N65-33307# Naval Postgraduate School, Monterey, Calif. Dept. of Aeronautics.
GAS TURBINE REGENERATOR FOULING INVESTIGATION Progress Report, 1965
Henry L. Kohler and James A. Miller 1965 44 p
(TN-65T-2; AD-469018)

The progress of an experimental investigation of fouling parameters in gas turbine regenerator compact matrices is

reported. Fouling effects on heat transfer rate and matrix pressure drop are presented for six matrices for gas inlet temperatures of from 600° F to 1050° F. Surface metal temperature in excess of 850° F is found to preclude fouling and to eliminate deposits previously formed at lower temperatures. Apparatus for planned chemical analysis of fuels and deposits is described and an outline of further investigative procedure is given. R.N.A.

N65-33334# British Internal Combustion Engine Research Association, Slough (England).
COMBUSTION IN DIESEL ENGINES Final Report, 1 Aug. 1964–31 Jul. 1965
W. S. May and W. P. Mansfield 12 Aug. 1965 7 p
(Contract DA-91-591-EUC-3488)
(ATR-5; AD-468744) CFSTI: HC $1.00/MF $0.50

An open-chamber single-cylinder 4-stroke diesel engine (4 1/4 in bore × 6 in stroke) has been run under simulated turbocharged conditions with a 7.8:1 compression ratio with the objective of studying combustion at low compression temperatures and thus finding the best combustion system for operation at very high loads with moderate cylinder pressures. The main problem was the high rate of pressure rise caused by a long ignition delay under these conditions. The size and number of holes in the injector nozzle was found to alter the rate of pressure rise without affecting ignition delay to an appreciable extent. Intake spray (fumigation) proved effective in reducing ignition delay and rate of pressure rise. Control of injection characteristics achieved with the Bicera Mark I fuel injection system gave improved control of combustion, and when used in conjunction with intake spray, a load of 400 psi bmep was carried at 1600 rpm with a fuel consumption of 0.41 lb/bhp hr while cylinder pressure and rate of pressure rise were limited to 1600 psi and 50 psi/degree respectively. Some tests were also made with higher and lower air swirl rates. Author

N65-33367*# General Dynamics/Convair, San Diego, Calif.
DEVELOPMENT OF A COAXIAL PLASMA GUN FOR SPACE PROPULSION Final Report
Terence J. Gooding, Alan V. Larson, Bruce R. Hayworth, and David E. T. F. Ashby Apr. 1965 77 p refs
(Contract NAS3-5759)
(NASA-CR-54245; GDA-DBE-64-052-4) CFSTI: HC $3.00/MF $0.75 CSCL 21C

To understand the physical phenomena occurring in pulsed plasma thrustors, diagnostic techniques were selected to give convenient, rapid estimates of thrustor performance. Calorimetric efficiency was the upper limit for thrust efficiency and ion velocity was measured by I_{sp}. Moving sheet accelerators for any I_{sp} between 2000 and 20000 seconds and thermal efficiencies in the order of 40% were designed and constructed, and two ways of improving efficiency are being investigated: nonuniform mass loading to make the current sheet accelerate continuously and maintenance of stationary or quasi-stationary current distribution. The stationary current sheet accelerator or pulsed arc gun has two distinct advantages over steady-state thrustors, namely: pulsed arc guns can be operated at very low average power while at very high peak powers and, because the propellant is also pulsed, very low ambient vacuum tank pressures can be maintained without large-scale pumping systems. Energy storage capacitors have also been developed.
M.W.R.

N65-33368*# Aerojet-General Corp., Sacramento, Calif.
260-IN.-DIA MOTOR FEASIBILITY DEMONSTRATION PROGRAM. VOLUME I: 260-SL MOTOR AFT-END IGNITION SYSTEM DEVELOPMENT
20 Aug. 1962 275 p refs
(Contract NAS3-6284)
(NASA-CR-54454; FPR-1) CFSTI: HC $6.00/MF $0.50 CSCL 21H

The 260-SL motor ignition system development program was conducted to demonstrate the capability of an aft-end solid-propellant igniter to ignite the 260-SL motors. A mathematical model was derived to define the gas dynamics of aft-end ignition and to provide the parameters required for aft-end ignition system design. The test program demonstrated the ignition capability of the ignition system and provided sufficient data to verify the mathematical model and the criteria used for the design of the ignition system. The 44-in.-dia subscale motor ignition system development program further verified the 260-SL motor ignition system design criteria and provided preliminary data on the igniter ejection sequence. The aft-end ignition performance in three 44-SS motors showed predictable and reproducible performance. All objectives of the development program were achieved and the ignition capability of the 260-SL motor ignition system was fully demonstrated.
Author

N65-33390# Catholic Univ. of America, Washington, D. C. Stress Analysis Labs.
AN EXPERIMENTAL STUDY OF STRESSES AT THE INTERFACE OF PROPELLANT GRAINS AND MOTOR CASES DUE TO THERMAL LOADING OF THE SHRINKAGE TYPE Progress Report
A. J. Durelli and V. J. Parks May 1965 6 p
(Contract AF 04(611)-10378)
(PR-2; AD-614656)

Experimental studies of stress at the end of the bonded interface between solid propellant rocket grains and their motor cases, due to thermal loading of the shrinkage type, are reported. A method of analyzing two and three dimensional models of solid propellant rocket grain shapes during shrinkage is discussed. A three dimensional photoelastic test in a thick slab of rectangular cross section, the central plane of which is under a state of plane strain, is described. Test results show that, using the bonding knife edge technique, the same distributions of stress can be obtained in a rectangular two-dimensional rubber plate bonded to a metal strip, as in the central plane of a square slab with the same ratio of height to length as in the rubber specimen. G.A.L.

N65-33539*# National Aeronautics and Space Administration. Lewis Reserch Center, Cleveland, Ohio.
NACA CONFERENCE ON TURBOJET ENGINES FOR SUPERSONIC PROPULSION A Compilation of Technical Material Presented
[1953] 606 p refs Conf. held 8–9 Oct. 1953
(NASA-TM-X-56788) CFSTI: HC $9.00/MF $3.00 CSCL 21H
(Declassified)

A number of technical papers related to a conference on turbojet engines for supersonic propulsion are presented. Papers are included on compressor and turbine aerodynamics, vibration and surge, turbine cooling, combustion, materials and structures, inlets and outlets, and engine and airplane performance. R.N.A.

N65-33543*# Purdue Univ., Lafayette, Ind.
AN EXPERIMENTAL INVESTIGATION OF THRUST VECTOR CONTROL BY SECONDARY INJECTION
Richard D. Guhse Washington, NASA, Sep. 1965 124 p refs
(Grant NsG-592)
(NSA-CR-297) CFSTI: HC $4.00/MF $1.00 CSCL 21H

An experimental investigation was conducted to examine the flow field produced when a secondary gas is injected into a supersonic primary stream. A preliminary analytical investigation revealed that several parameters were influential in determining the nature of the flow field produced by secondary injections and the resulting side force. Experiments were also conducted in a Mach 2.0, two-dimensional blow down wind tunnel utilizing air as the primary and secondary gases. The secondary gas was injected through a rectangular slot extending the width of the primary nozzle. The results were compared with the values of side force computed with the aid of the two theories. It was found that the theoretical results compared favorably with experimental results only over a specific range of the variables, indicating ranges of applicability for each of the proposed theories. R.W.H.

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N65-32564# Science Council of Japan, Tokyo. Ionosphere Research Comm.

REPORT OF IONOSPHERE AND SPACE RESEARCH IN JAPAN, VOL. 19, NO. 1

Takesi Nagata, ed. Mar. 1965 119 p refs Sponsored by Ministry of Education CFSTI: HC $4.00/MF $0.75

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N65-32567 Doshisha Univ., Kyoto (Japan). Science and Engineering Research Inst.

GEOMAGNETIC PULSATIONS AND THE EXOSPHERE. PART III: ION DENSITY DISTRIBUTION IN THE EXOSPHERE

Tai-ichi Kitamura *In* Sci. Council of Japan Rept. of Ionosphere and Space Res. in Japan, Vol. 19, No. 1 Mar. 1965 p 21–29 refs (See N65-32564 21-29)

The ion density distribution in the exosphere, assuming the diffusive equilibrium type of distribution is investigated, solving a spatial part of the fundamental equation of oscillation in the exosphere, with an assumption that geomagnetic pulsations in the polar regions are standing waves along the field-lines of magnetic force. The estimated ion densities assuming a temperature of 1250° K in the exosphere are about 90–700 particles/cc at three earth radii, and 60–400 particles/cc at five earth radii, which are roughly consistent with values calculated from whistler observations. Author

N65-32568 Tohoku Univ., Sendai (Japan). Onagawa Magnetic Observatory.

A NEW INDEX OF GEOMAGNETIC PULSATION AND ITS RELATION TO SOLAR M-REGION. PART III: ANNUAL VARIATION AND LATITUDINAL DEPENDENCE OF M-REGIONS

Takao Saito *In* Sci. Council of Japan Rept. of Ionosphere and Space Res. in Japan, Vol. 19, No. 1 Mar. 1965 p 30–46 refs (See N65-32564 21-29)

Geomagnetic disturbances due to solar M-regions often seem to show apparent annual variation; these are activated either near vernal or autumnal equinox. A geomagnetic pulsation index from 1959 to 1964 and three-hour planetary index from 1931 to 1934 are presented as examples of this variation, which is interpreted by the axial effect of the sun; in other words, an effect of the variation in the earth's heliographic latitude. In order to explain the reason why the clearest 27-day recurrence tendency of M-disturbances appears only in the declining phase of the solar cycle, the following hypothesis is introduced. Although M-regions are alive in all phases, they change their heliographic latitudes depending on the phase like other solar phenomena; M-regions which appear in high latitudes in minimum phase shift their locations gradually to lower latitudes as the phase changes to inclining, maximum, declining, and again to minimum. Author

N65-32569 Tokyo Astronomical Observatory (Japan).

ATMOSPHERIC ABSORPTION IN MICROWAVE SOLAR OBSERVATION AND SOLAR FLUX MEASUREMENT AT 17 Gc/s

Atsushi Tsuchiya and Kiyoshi Nagane *In* Sci. Council of Japan Rept. of Ionosphere and Space Res. in Japan, Vol. 19, No. 1 Mar. 1965 p 47–50 (See N65-32564 21-29)

Solar fluxes in the microwave region are measured with a 17 Gc/s radio polarimeter. Radio wave absorption is assumed to be dependent only on relative humidity and zenith distance of the sun. Density distributions of water vapor and oxygen are approximated to be exponential by use of radiosonde data. When the antenna temperature of the sun is plotted against relative humidity, there appears to be no systematic correlation for results obtained at various times during the day or between dry and rainy conditions. M.W.R.

N65-32570 Japan. Ministry of Transportation, Tokyo. Radio Research Labs.

VARIATION IN IONOSPHERIC ELECTRON CONTENT MEASURED BY RADIO WAVES FROM SYNCOM 3

Yoshiaki Nakata *In* Sci. Council of Japan Rept. of Ionosphere and Space Res. in Japan, Vol. 19, No. 1 Mar. 1965 p 51–53 (See N65-32564 21-29)

A horizontal dipole antenna with a corner deflector is used to determine if measurements of Faraday rotation of radio waves obtained from Syncom 3 can be used to indicate diurnal variations of the ionosphere. Two linear receiving antennas, at an angle of about 60 degrees, are also used to detect changes in electron content of the ionosphere and to determine rotation as a function of time. Traces obtained with both types of antenna show distinct changes during the course of the day. From sunrise to about 11 am the total electron content along the wave path increases, with high figures obtained by the horizontal antenna; a decrease in electron content occurs after 11 am. It is concluded that a stationary satellite such as Syncom 3 can be used to measure electron content of the ionosphere, but the 136 Mc/s emitted from Syncom 3 must be lowered to about 40 Mc/s to obtain precise measurements. M.W.R.

N65-32571 Science Council of Japan, Tokyo. Ionosphere Research Comm.

CATALOGUE OF DISTURBANCES IN IONOSPHERE, GEOMAGNETIC FIELD, FIELD INTENSITY OF RADIO WAVE, COSMIC RAY, SOLAR PHENOMENA AND OTHER RELATED PHENOMENA, NO. 48, SEPTEMBER 13–19, 1963

In its Rept. of Ionosphere and Space Res. in Japan, Vol. 19, No. 1 Mar. 1965 p 61–119 (See N65-32564 21-29)

Simultaneous observations from many stations are recorded for a magnetic storm which occurred from September 13 to 19, 1963. Data on solar flares are tabulated; and daily solar radio emission recordings are presented. Atmospheric radio noise, airglow, ionospheric content and f-plots, geomagnetic fields, earth current, and induction magnetron data are illustrated. Storm time, commencement, and range of the principal magnetic storms are tabulated, and indices for a three-hour range of earth-current potential are given. Cosmic ray intensity and field intensity of radio waves are also presented in this catalog. M.W.R.

N65-32678 Library of Congress, Washington, D. C. Aerospace Technology Div.

FORECASTING SOLAR FLARES

D. Michaels *In its* Foreign Sci. Bull., Vol. 1, No. 8 Aug. 1965 p 18–20 refs (See N65-32675 21-34)

Soviet press reports indicate that A. B. Severnyy and his colleagues at the Crimean Astrophysical Observatory have developed a method of forecasting the onset of solar flares based on analysis of solar magnetic fields. The development of a reliable method of predicting radiation conditions in interplanetary space is of the utmost importance to the future of manned space travel. Author

N65-32719*# California Univ., Berkeley. Space Sciences Lab.

AURORAL ZONE PEARL PULSATIONS

R. L. Mc Pherron and S. H. Ward 30 Jun. 1965 47 p refs (Grants NsG-243-62; NSF GP-1775; Contract Nonr-222(89)) (NASA-CR-64468) CFSTI: HC $2.00/MF $0.50 CSCL 20H

Pearl Pulsations (PP), taken from Pc 1 band micropulsations observed in the auroral zone during one solar rotation, were analyzed and the following observed: There is no correlation of PP with electron precipitation indicated by bremsstrahlung recorded at balloon altitude; PP activity occurs at the time of a sudden commencement and can have an hourly repetition of occurrence for five or six hours thereafter; the K_p and A_p indices are too coarse for adequate representation of geomagnetically disturbed times when studying the dependence of PP occurrence on geomagnetic activity; there may be a slight increase of PP period with increase in K; PP have higher amplitudes when K values are higher; Pc-3, 4 band activity may be used as a good predictor for PP occurrence since there is an inverse correlation between PP and Pc 3–4. For days rated as quiet by Pc-3, 4 activity, PP may occur at any time during the daylight hours; PP are distributed throughout the daylight hours on quiet days and appear only within an hour or two of 1800 lmt on disturbed days; observed polarization diagrams cannot be explained in terms of superimposed elliptically polarized waves. R.N.A.

N65-32726*# National Aeronautics and Space Administration, Washington, D. C.

THE NATURE OF A WEAK CHROMOSPHERIC FLARE [O PRIRODE SLABOY KHROMOSFERNOY VSPYSHKI]

M. N. Stoyanova Sep. 1965 15 p refs Transl. into ENGLISH from Solnech. Dannyye (USSR), no. 3, 1963 p 46–55 (NASA-TT-F-248) CFSTI: HC $1.00/MF $0.50 CSCL 04A

Studies were made on a weak chromospheric flare using a horizontal solar telescope. Spectrograms were obtained for the hydrogen and HeD_3 segments. Fluctuations in the image did not exceed 2 inches in amplitude. The contours of the D_3 line were shallow suggesting that the optical thickness of the flare was slight. Numbers of atoms were computed along the line of sight for the second and third levels and the ratio was found to be 1.27 to 10^{-2} (upper level to lower level), which compares with the theoretical value. The contours for emission and absorption of the D_3 line exhibit a Gaussian form. The contours for hydrogen are not Gaussian. In explaining these latter contours, it was found that for any assumed relative optical thickness in the flare, a source function was obtained that was larger throughout the contour than the function obtained from population tables corresponding to the case of photospheric radiation. The observed radiation was not caused by scattering. A two layer model explained the shape of the contour. It was concluded that the hydrogen emission cannot be explained by scattering photospheric radiation, but is caused by an increased population at the third level. R.N.A.

N65-32735# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DETERMINATION OF THE EFFECTIVE COLLISION FREQUENCY IN THE IONOSPHERE

V. D. Gusev 13 Jul. 1965 7 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. Mat., Mekhan., Astron. Fiz. i Khim. (Moscow), no. 1, 1959 p 105–108 (FTD-TT-65-101/1+4; AD-618091)

A method of determining the distribution of effective collision frequency in the ionosphere was developed for the isotropic medium, and the monotonic change of the ionosphere with altitude. The altitude frequency characteristic, and the curve of dependence of the absorption on the frequency are considered in the equations. It was concluded that by applying the formulas successively to each layer, the results obtained can be considered as first approximations for computing the distribution law of effective collision frequency in the ionosphere even in the case of multistratification. M.G.J.

N65-32769# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

TRANSPORT OF RADIOACTIVE AEROSOLS IN THE TROPOSPHERE FROM THE NORTHERN TO THE SOUTHERN HEMISPHERE

Yu. V. Krasnopevtsev 9 Jul. 1965 12 p refs Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 4, 1964 p 3–8 (FTD-TT-65-342/1+2+4; AD-617948)

Distribution data of radioactive gas concentrations from nuclear explosions in the Northern Hemisphere were used to evaluate the average rate of transition through the equatorial zone into the Southern Hemisphere. Air samples were taken over the Indian and Pacific Oceans by two weather observation ships from September 1916 through January 1962, and the total β-activity was compounded from the quantitative content of Ce^{144}, Cs^{137}, and the β-activity of the air specimens sampled at different points. The concentrations of radioactive products were considerably lower in the Southern Hemisphere than in the Northern Hemisphere. Comparison of the boundaries of fresh fission products established a three month interval for the passing of radioactive aerosols across the equatorial zone. Evaluations on the basis of overall increased radioactive products found a transition time across the equatorial zone of three to three and one half months. G.G.

N65-32890# Kyoto Univ. (Japan). Institute of Astrophysics.
EXTREME ULTRAVIOLET SOLAR EMISSION LINES AND THE TRANSITION LAYER BETWEEN THE CHROMOSPHERE AND THE CORONA
Shin Koyama 1963 21 p refs *Its* Contrib. No. 119 CFSTI: HC $1.00/MF $0.50

Models of the solar transition layer between the chromosphere and the corona are constructed to give a reasonable explanation for the rocket- and eclipse observations and also for radio emission. Models for the undisturbed sun, both at the sunspot maximum and minimum, and for the active region are proposed in the present investigation. The lower and the higher parts of models for the undisturbed sun are consistent, respectively, with the spicule and the interspicule models previously given by several authors. It is estimated that, at the phase of sunspot maximum, the total area occupied by the active regions is 10 ~ 20 per cent of the whole solar surface, and some 90 per cent of the extreme ultraviolet flux originates in such restricted active regions. Author

N65-32899# Pennsylvania State Univ., University Park. Dept. of Electrical Engineering.
GENERALIZATION OF THE D-REGION ELECTRON DENSITY SYNTHESIS TECHNIQUE
K. H. Care [1965] 72 p refs
(Grant NSF GP-846)
(SR-248)

The present work deals with the generalization of the technique of synthesizing the D-region electron density profiles based on the radio wave amplitude and phase interaction measurements. The technique was extended to include the generalized expression for the complex index of refraction, instead of the classical Appleton-Hartree equations, in both the amplitude and phase interaction equations. The classical synthesis technique and the generalized synthesis technique are compared using theoretical data and real data. The generalized synthesis technique is found to produce electron densities which are higher than those produced by the classical synthesis technique. Also, it was found that the generalized synthesis technique produces more reliable results when the interaction data are not available near the base of the ionosphere. Mean electron density profiles for the months of January, February and March, 1964, are presented together with the results showing diurnal and seasonal variations. Author

N65-32953*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AIMP SUMMARY DESCRIPTION
J. J. Madden Aug. 1965 53 p
(NASA-TM-X-55280; X-672-65-313) CFSTI: HC $3.00/MF $0.50 CSCL 20H

Radiation experiments for energetic particles; passive experiments; and experiments for an Ames magnetometer, a GSFC magnetometer, meteorite flux, and solar-cell damage, all to be conducted with a lunar-anchored satellite, are described. The structure, stabilization, retromotor, thermal control, telemetry systems, power systems, tracking, and ground systems for the AIMP-D spacecraft are discussed. Also discussed are reliability, quality assurance, decontamination and clean-room assembly, testing, and the launch vehicle. L.S.

N65-32967*# National Aeronautics and Space Administration, Washington, D. C.
THE NATURE AND LOCALIZATION OF CHROMOSPHERIC FLARES [K VOPROSU O PRIRODE I LOKALIZATSII KHROMOSFERNYKH VSPYSHEK]
Yu. M. Slonim Sep. 1965 14 p refs Transl. into ENGLISH from Soln. Dannyye (USSR), no. 4, 1963 p 67–77
(NASA-TT-F-250) CFSTI: HC $1.00/MF $0.50 CSCL 04A

The relationship of flares to solar prominences has been discussed. Three types of flares are considered. Type A is shown to have plasma with sharp, short pulse jets. Type B a strong, contracted radiation burst, and Type C a long-duration pulsating character. The first two appear strictly in the chromosphere, whereas Type C has a coronal origin. In order to compare these various flare types objectively, the flare intensity was replaced by the line width characteristic H_α. It is shown that Type C flares are generated principally in the growth phase of sunspot groups, whereas Types A and B are found in the decaying phase. It is concluded that these facts show the differences between the fast-growing flares of Types A and B, and the pulsating flares of Type C. The analysis is extended to connect Type C flares with loop prominences. Various reasons are given for the hypothesis, emphasizing the similarity between pulsating emission center for Type C flares and the nature of nodal and jet radiation of prominences. Author

N65-32969*# National Aeronautics and Space Administration, Washington, D. C.
THE RELATIONSHIP BETWEEN PHOTOSPHERIC AND CHROMOSPHERIC PROCESSES IN THE ACTIVE REGION DURING FLARES [O SVYAZI FOTOSFERNYKH I KHROMOSFERNYKH PROTSESSOV V AKTIVNOY OBLASTI VO VREMYA VSPYSHEK]
S. I. Gopasyuk, M. B. Ogir', and T. T. Tsap Sep. 1965 8 p refs Transl. into ENGLISH from Soln. Dannyye (USSR), no. 4, 1963 p 77–81
(NASA-TT-F-251) CFSTI: HC $1.00/MF $0.50 CSCL 04A

Sunspot activity and solar flares accompanied by particle emissions along radial lines have been carefully studied using motion pictures and photoheliograms. A superposition of the two has allowed investigation of detailed sunspot distributions. The data obtained have been used to calculate the total number of atoms in the active region of the chromosphere and in the whole solar corona. When these values are compared with the total number of atoms, the source of particle emission and strong flares is found to be in the photosphere. Furthermore, magnetograph records indicate an increase in radial velocity in photospheric levels during solar flares. It is shown that among the increased mass of ascending substances

in the photosphere, sunspot displacement, particle surges in the chromosphere above the sunspots during solar flares, and the solar flares themselves, there exists a very intimate relationship. All these phenomena are then assumed to be due to a single primary process occurring, in all probability, within or immediately below the photosphere. Author

N65-33004# RAND Corp., Santa Monica, Calif.
CHANGES IN THE CHEMICAL COMPOSITION OF THE ATMOSPHERE FOLLOWING INTENSE IONIZATION IMPULSES
L. M. Branscomb (Colorado Univ.) and R. E. Le Levier Dec. 1964 25 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4364-PR; AD-609792)

Free atoms of oxygen and nitrogen are introduced into the ambient atmosphere when electrons dissociatively recombine with positive ions. In the lower D-layer of the ionosphere it is found that for fractional ionization levels greater than about 10^{-9} this process dominates the attachment mechanism, thereby leading to the introduction of free atoms as contaminants. The nitrogen atoms oxidize to form nitric oxide on a relatively fast time scale. At a slower rate, the oxygen atoms react to form ozone. Finally, the nitric oxide and ozone react to form nitrogen dioxide. The concentration and the rate of formation of the species is studied as a function of altitude and intensity of the initial impulse of ionization. It is found that for initial ionization levels greater than about 10^{-5}, the ultimate ozone and nitrogen dioxide concentrations are determined solely by the reaction rate coefficients and the ambient concentration of molecular oxygen and are independent of the initial electron density. Author

N65-33155# Massachusetts Inst. of Tech., Cambridge.
OBSERVATIONAL WORK ON COSMIC GAMMA RAYS
George W. Clark [1965] 12 p
(Grants NsG-386; AF-AFOSR-546-64; Contract AT(30-1)-2098)
(MIT-2098-123)

Observational data on cosmic photons in the energy range 10^4 to over 10^{15} ev are analyzed. A high altitude balloon experiment, in which a scintillation detector was used successfully to observe cosmic X-rays, contributed strong evidence against the simple neutron star hypothesis for the X-ray source in the Crab Nebula. A similar experiment, with a lead shield interposed between a large gamma ray detector and SCO-X1, produced data that puts the hypothetical electron cloud needed to produce the SCO-X1 X-rays by the inverse Compton process far outside the galaxy and probably beyond belief. An array of scintillation detectors were used to study the distribution of penetrating particles for a large number of gamma ray air showers of primary energies from 10^{15} to 10^{16} ev; the results fail to establish that the electromagnetic showers observed in this experiment were caused by primary gamma rays. J.M.D.

N65-33277*# Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies.
THE FLUX AND ENERGY SPECTRUM OF PRIMARY COSMIC RAY ELECTRONS
Jacques l'Heureux and Peter Meyer [1965] 12 p refs
(Grant NsG-144-61)
(NASA-CR-64806; ET-INS-65-56) CFSTI: HC $1.00/MF $0.50 CSCL 20H

An experiment is described which gives an approximate energy spectrum of the primary electron component in cosmic radiation. Two balloon flights floating under about 4 g/cm^2 of residual atmosphere were made. The instrument which was used is described in detail and consists of scintillation, Cerenkov, and anticoincidence counters. The equipment was calibrated in a monoenergetic beam of electrons at energies ranging from 700 MeV to 4 BeV. Among the determinations made from these calibrations were the pulse height in the lead glass Cerenkov counter, and the resolution of the scintillation counters. The spectrum is represented as a power law of the form $dj/dE = 11 \times E^{-1.6}$ (m^2 sec sr BeV)$^{-1}$ where E is measured in BeV and falls inside the limits set by earlier determinations. C.T.C.

N65-33284*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
THE ELECTRIC FIELD GENERATED BY A ROTATING MAGNETIZED SPHERE
Edward W. Hones, Jr. and John E. Bergeson [1965] 29 p refs *Its* Rept.-65-23
(Grant NsG-233-62)
(NASA-CR-64816) CFSTI: HC $2.00/MF $0.50 CSCL 20H

Presented are determinations of the electric field of a steadily rotating, uniformly magnetized, and perfectly conducting sphere with arbitrarily aligned axes of rotation and magnetization. The sphere is surrounded by, and in direct contact with, a tenuous plasma in which the conductivity parallel to the magnetic field lines is infinite and that perpendicular to the magnetic lines is zero. The electric field in a nonrotating frame of reference is calculated and then used to determine the $\vec{E} \times \vec{B}$ drift and energy changes of the plasma particles. As in the case with aligned (antiparallel) axes, the charged particles were found to co-rotate with the sphere. The electric field in a reference frame rotating with the sphere is identically zero for the symmetric (dipole) magnetic field under consideration. When the magnetic and rotational axes are parallel or anti-parallel, co-rotation of sphere and plasma is caused by $\vec{E} \times \vec{B}$ drift. For all other orientations Fermi acceleration plays a role in causing co-rotation. Speculation is made concerning the role of the earth's rotation in determining the characteristics of the electric and magnetic fields, the energy plasma, and the high energy trapped radiation in the magnetosphere. S.C.W.

N65-33285*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
INFLUENCE OF THE EARTH'S ROTATION UPON THE INTERACTION OF THE SOLAR WIND WITH THE MAGNETOSPHERE
Edward W. Hones, Jr. Jul. 1965 42 p refs *Its* Rept. 65-26
(Grant NsG-233-62)
(NASA-CR-64820) CFSTI: HC $2.00/MF $0.50 CSCL 20H

Presented are results of an experimental and theoretical analysis of the influence of the earth's rotation on the coupling of solar wind energy into the magnetosphere. Described are experiments, conducted with objects in water, which demonstrate that circulation established by bodies rotating in a viscous fluid may be modified and its velocity enhanced if the fluid is streaming past the bodies. The additional circulation energy is derived from reorientation of the stream flow near the bodies. These demonstrations suggest that the earth's rotation plays a definite role in coupling the solar wind's energy. On the basis of data derived from the electric field configuration in a model of the magnetosphere, and from demonstrations of the behavior of a stream of viscous fluid as it flows past rotating bodies, a theory is proposed to account for the energy-coupling mechanism. Included is a discussion of existing theories which attempt to explain this phenomenon and the feasibility of qualitatively determining the influence of the earth's rotation experimentally with a rotating terrella in the laboratory. S.C.W.

N65-33362*# Delta Data Systems, Inc., College Park, Md.
IMPROVED DATA HANDLING TECHNIQUES FOR SPECTROMETER DATA
Sep. 1965 31 p refs
(Contract NAS5-9087)
(NASA-CR-307) CFSTI: HC $2.00/MF $0.50 CSCL 03B

A mathematical method to improve resolution and select solar emission lines in spectrometer data is presented. The method depends upon non-linear averaging, numerical bandpass filtering, and second differences. Spectra representing scans of the solar emission intensity from 40 to 400 Å are computed. Line intensities as low as 35 counts per second above background and separated by 0.4 Å or more are detected. Computer programs for the GSFC direct coupled IBM 7050/7094 have been written to execute the algorithms developed and are presented. Author

N65-33375# Oslo Univ., Blindern (Norway). Dept. of Astrophysics.
RESEARCHES IN SOLAR PHYSICS DURING 1964 Scientific Report No. 1
Svein Rosseland 30 Jan. 1965 24 p refs
(Contract AF 61(052)-743)
(AFCRL-65-363; AD-618222) CFSTI: HC $1.00/MF $0.50

Studies have been made on the structure of storm bursts in the meter wave region, and their interrelations. A preliminary excursion into the band 310–340 mc showed very few bursts which might be ascribed to a solar origin. This may, perhaps, simply be a result of the low activity of the sun in general. A comparison of meter wave observations of the sun at Oslo with NERA (The Netherlands) and Tokyo indicates that the Oslo data have a high degree of reliability and stability, even over a 10 year period. Some progress is reported in a study of the new type of bursts named "flash-bursts" by Elgaroy. A study of the lifetime of sunspot groups and of magnetic properties of sunspot groups led Ringnes to the discovery of several new tendencies of the sun to display secular variations,—different from one cycle to the next. Jensen and Maltby discussed the transparency properties of sunspot models and pointed out that some current models fail to stand up to the test in this respect. The continuation of Maltby's work on Evershed effect and wiggles was continued with fair success, in spite of the low solar activity. In this connection Brahde made a theoretical study of the instrumental width of spectral lines taken with the large spectrograph of the solar tower. Author

N65-33478# RAND Corp., Santa Monica, Calif.
DETECTION OF THE ELECTROMAGNETIC RADIATION FROM NUCLEAR EXPLOSIONS IN SPACE
W. J. Karzas and Richard Latter Oct. 1964 43 p refs
(RM-4306; AD-607788)

The electromagnetic signal generated by interaction of nuclear-explosion-induced electric currents with the geomagnetic field can serve as a basis for detecting such explosions at extreme distances from the earth. In the present paper, an earlier theory of this phenomenon developed by the authors is extended to allow estimates of the maximum detection range. It is concluded that this electromagnetic signal may be detectable at distances of the order of $10^7 \sqrt{Y_{KT}}$ kilometers from a nuclear explosion of total yield Y_{KT} kilotons. Author

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N65-32411* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
EFFECT OF NON-GRAVITATIONAL PERTURBATION ON MINIMUM ENERGY INTERPLANETARY TRANSFER ORBITS
G. A. Flandro *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 1–8 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

The relative importance of several nonaerodynamic, nongravitational orbital perturbations is established. Numerical results are given for the following effects: (1) solar radiation pressure; (2) reaction forces due to leaks in pressurized systems; (3) perturbations due to unbalanced attitude control reaction devices; (4) reaction force due to directional antenna emission; and (5) reaction force due to unsymmetrical emission of thermal energy from the space craft surfaces. Comparisons of these effects are made in terms of change of magnitude of the miss vector at the target planet which would result if the orbit were not corrected for the perturbing effect. No attempt was made to include estimates for the perturbing effect of micrometeorite impacts due to the present uncertainty in flux density. Some studies indicate that perturbations from this source could exceed the solar radiation pressure effects. The results for the gas leak perturbation can be used for a rough estimate of the effect of micrometeorite flux if the acceleration is assumed constant in magnitude and direction throughout the flight. E.E.B.

N65-32412* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AN INVESTIGATION OF THE ORBIT REDETERMINATION PROCESS FOLLOWING THE FIRST MIDCOURSE MANEUVER
J. O. Light *In its* Space Program Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 8–17 (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

An analytical simple-model investigation of the orbit redetermination process following the first midcourse maneuver indicates that there are four effects which contribute to orbit determination knowledge. These effects contribute to orbit determination knowledge because of the conventional position parallax they exhibit, but more important, because of the velocity parallax caused by the relative velocity of the probe and observing station. Analytic studies indicate that the rotation of the observing stations, and in particular the velocity parallax of that rotation, actually dominates the orbit redetermination process. This leads to the conclusion that the orbit determination program will furnish poor declinations of the outgoing asymptote and this conclusion is corroborated by the observed evidence of past orbit determination studies. Further orbit redetermination studies are required to determine exactly how these phenomena will affect the trajectory selection criteria. E.E.B.

N65-32574*# National Aeronautics and Space Administration, Washington, D. C.
SPACE EXPLORATION—WHY AND HOW
Edgar M. Cortwright [1964] 22 p
(NASA-EP-25) CFSTI: HC $1.00/MF $0.50 CSCL 22A

The question "Why explore space when so much of our earth remains unexplored?" is answered in a paper based on an address to the Norwegian Geographical Society. Main Sections deal with the space around the earth, atmospheric circulation and the weather, the earth, and the moon and the planets. Illustrations are included of the Orbiting Geophysical Observatory and schematics of the ionosphere and solar effects on the earth's atmosphere. Also presented are pictures of storms and fronts, the life cycle of a cyclone, and limitations of satellite radar for measuring precipitation. The Tiros, Toss

(USWB), and Nimbus meteorological satellites are diagrammed; and pictures of satellite photography are included. The significance of high resolution lunar photography is considered, and lunar photographs taken by Ranger VII are presented. M.W.R.

N65-32625# Lockheed Missiles and Space Co., Palo Alto, Calif.

A SIMPLE EXPLANATION FOR THE SEMI-ANNUAL EFFECT APPEARING IN SATELLITE ORBITAL DECAY DATA

Albert D. Anderson Aug. 1965 32 p refs
(LMSC-6-75-65-43)

A semiannual effect has been found by Paetzold and Zschörner in satellite orbital decay data. They interpreted the cause of this effect to be a world-wide semiannual density variation in the upper atmosphere. However, the analysis presented in this article reveals that this effect is correlated definitely with the differences in latitude between satellite perigee and subsolar point. This relation is explained by inferring that the prominant minimums in orbital decay values near the solstices result from a marked latitude variation in density existing in the winter hemisphere at this time, with the density at the winter pole indicated to be much lower than at the subsolar point (or equator). A contributing factor is that the perigee of a given satellite, which changes latitude regularly from north to south of the subsolar point and vice versa, reaches its maximum distance north or south of the subsolar point near the solstices. This hypothesis is able to explain qualitatively all of the observed features of the semiannual effect. Author

N65-32717# Lockheed Missiles and Space Co., Sunnyvale, Calif.

ON INTERMEDIATE ORBITS OF ARTIFICIAL EARTH SATELLITES

E. P. Aksenov [1965] 9 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Fiz.-Astron. Ser., no. 3, 1965 p 36–45

Previously, formulas describing an intermediate orbit of an artificial earth satellite were derived which express the conical satellite coordinates as explicit functions of some intermediate variable, which in turn was connected to time. However, the method of calculating the satellite coordinates by means of such formulas was not unique. Other forms of the solution of this problem are derived in this paper. These describe the intermediate motion of the artificial earth satellite in terms of six arbitrary constants. In deriving the formulas the expansions were such that the formulas are valid for any eccentricities and inclinations of the satellite orbit. E.E.B.

N65-32725*# National Aeronautics and Space Administration, Washington, D. C.

ROCKET FLIGHT ENGINEERING

Eugen Sänger Sep. 1965 351 p Transl. into ENGLISH of the book "Raketenflugtechnik" Berlin, Verlag von Oldenburg, 1933
(NASA-TT-F-223) CFSTI: HC $7.00/MF $1.75 CSCL 22C

General engineering principles of rocket flight are discussed. Discussions are included on propulsive forces, the theory of rocket motors, the efficiency of a rocket motor, propellants, air forces, lift in the subsonic and supersonic regions, resistance in the subsonic and supersonic regions, fuselage and wing design for a rocket aircraft, flight paths, structure of the atmosphere, the high altitude flight phase, the ascent and descent path, and the performance of a rocket aircraft. R.N.A.

N65-32752*# National Aeronautics and Space Administration, Washington, D. C.

AN UNEQUALED SCIENTIFIC EXPERIMENT IN SPACE [BESPRIMERNYY NAUCHNYY EKSPERIMENT V KOSMOSE]

M. V. Keldysh Aug. 1965 14 p Transl. into ENGLISH from Priroda (Moscow), No. 4, 1965 p 9–16
(NASA-TT-F-9451) CFSTI: HC $1.00/MF $0.50 CSCL 22A

Personal accounts of the preparations for the flight of the Russian spacecraft Voskhod-2, and the execution of various experiments including human egrees into space, are given by pilot-cosmonauts P. I. Belyayev and A. A. Leonov. J.M.D.

N65-32790# Lockheed Missiles and Space Co., Sunnyvale, Calif.

[ARTIFICIAL EARTH SATELLITES]

T. V. Kasimenko and M. A. Lur'e [1965] 3 p Transl. into ENGLISH from Vestn. Akad. Nauk. SSSR (Moscow), no. 5, 1965 p 94–95

A synopsis of work in synchronous photographic observations for cosmic triangulation purposes, and in basic visual observations of short-range changes in the atmospheric density is given. Members of the conference discussed the various aspects of the operation of optical observation stations for artificial earth satellites; emphasis was placed on the utilization of modern computer technology for the processing of observational results, the construction of new cameras, and the photometric observations of earth satellites. G.G.

N65-32874*# National Aeronautics and Space Administration, Washington, D. C.

AERIAL MISSION FOR THE STUDY OF THE AURORA AND OF THE SKY AT NIGHT IN THE REGION OF HIGH LATITUDES

Daniel Barbier, Marc Fafiotte, and Gilbert Weill Aug. 1965 10 p ref Transl. into ENGLISH from Ann. Geophys. (Paris), vol. 18, no. 2, 1962 p 221–224
(NASA-TT-F-8760) CFSTI: HC $1.00/MF $0.50 CSCL 04A

An aerial mission was carried out from 4 to 11 December in the auroral region, during a period of magnetic calm. The auroral arc is emitted at a slightly greater altitude for the radition 6,300 than for 5,577. The relation of the intensities measured at the same distance from the zenith for these two radiations is a function of the distance of the arc from the observer. The geographic position of the arc is connected with the magnetic activity. The intensity of the nightly luminescence for the two radiations under consideration has remained weak, and its study was hampered by the aurora, and at the lower latitudes by clouds. Author

N65-32884*# New Mexico State Univ., University Park. Observatory.

GROUND-BASED PHOTOGRAPHY OF THE MARINER IV REGION OF MARS

J. C. Robinson Aug. 1965 8 p refs
(Grant NsG-142-61)
(NASA-CR-64466; TN-701-66-10) CFSTI: HC $1.00/MF $0.50 CSCL 03B

Observable portions of the path of Mariner IV at central meridian longitudes from 90° to 240° were studied from 251 plates which included ultraviolet, blue, green, red, and near infrared regions. An atmospheric haze appears to have obscured some yf the surface details of Mars, but the dark features recorded along the Mariner path are summarized. These include the positions of oases, canals, and a caret; three of the features were prominent enough for direct positional determination with a Mann measuring engine, but crude determinations were made for the other six features. The approximate areas and positions of regions of clouds or bright haze are also given. M.W.R.

N65-32900# Yale Univ. Observatory, New Haven, Conn.
[OBSERVATION OF FLARE STARS AND LUNAR LUMINESCENCE]
James N. Douglas 15 Jul. 1965 14 p refs
(Grant Nonr(G)-00014-64)
(AD-617789)

Lunar and stellar observations, and equipment modifications are briefly reviewed. Observations showed that Jovian H α auroras are absent to unexpectedly low levels, and that strong H α flares are not of great frequency in late-type dwarfs. A 20-inch reflecting telescope, and a dual-channel pulse counting photoelectric spectrophotometer, designed to work accurately through haze and thin clouds, were constructed. Calculations for incidence predictions of flares are included. M.G.J.

N65-32966*# National Aeronautics and Space Administration, Washington, D. C.
THE PROBLEM OF ACTIVE LONGITUDES ON THE SUN [K VOPROSU OB AKTIVNYKH DOLGOTAKH NA SOLNTSE]
Yu. I. Vitinskiy Sep. 1965 10 p refs Transl. into ENGLISH from Soln. Dannyye (USSR), no. 3, 1963 p 64–70
(NASA-TT-F-249) CFSTI: HC $1.00/MF $0.50 CSCL 03B

The position of the active solar longitudes is studied by the method of isolines. Choice of an unsuitable scale for measuring active areas in longitudinal direction, or of an incorrect zero reference point may lead to erroneous results when this method is used. The Deslandres 30° longitudinal scale unit was chosen, because it covers the population belt of recurrent sunspots. Maps of isolines of sunspot areas have been drawn on which the active regions were isolated from others. That zero point was chosen which yielded the greatest mean longitudinal gradient in the maximum area of sunspots. The zero points of the Northern and Southern Hemispheres did not coincide in many cases. An irregular oscillation of the positions of active solar longitudes was noted on the maps which had been drawn and an attempt was made to find more accurate positions of the centers of active longitudes. The centers were shifted in one direction in the Northern Hemisphere but no such definite direction was noted in the Southern Hemisphere. Vitinskiy concludes that the subphotospheric layers associated with active longitudes rotate faster in some 11-year cycles and slower in others. Author

N65-32974*# National Aeronautics and Space Administration, Washington, D. C.
COLLECTED WORKS OF K. E. TSIOLKOVSKIY. VOLUME II: REACTIVE FLYING MACHINES
A. A. Blagonravov, ed. Sep. 1965 629 p refs Transl. into ENGLISH of the book "K. E. Tsiolkovskiy. Sobraniye Sochineniy. Tom II. Reaktivnyye Letatel'nyye Apparaty" Moscow, Izd. Akad. Nauk SSSR, 1954
(NASA-TT-F-237) CFSTI: HC $4.50/MF $3.00 CSCL 22A

Volume II of the historical works of K. E. Tsiolkovskiy dealing with the early thaory of rocket propulsion and dynamics is presented. R.N.A.

N65-33045# Kyoto Univ. (Japan). Inst. of Astrophysics.
PHOTOMETRY OF THE INNERMOST SOLAR CORONA-OBSERVED AT THE TOTAL SOLAR ELLIPSE OF FEBRUARY 5, 1962. I: GENERAL CORONA AND POLAR RAY
Tokio Tsubaki, Susumu Tominaga, Jun Kubota, and Ichiro Kawaguchi 1964 11 p refs *Its* Contr. No. 130 CFSTI: HC $1.00/MF $0.50

At the total solar eclipse of Feb. 5, 1962, seven photographs of the innermost solar corona were obtained by a long focal length camera. The intensity distribution along the sun's radius was measured up to R = 1.3R $\odot$. In the range of 1.15 < R/R $\odot$ < 1.3, the intensity gradient in the east equatorial region is in good agreement with the van de Hulst model, but rather steeper in the region of R < 1.15R $\odot$. The corona was brighter in the north polar region than in the south. The apparent number distribution and the width of the polar ray and the intensity gradient in the central part of the particular four polar rays were measured. The number of polar rays is minimum around the position angle 12° ~ 15°. The average width of polar ray is 0.038R $\odot$. Inside 1.15R $\odot$, the intensity gradient along the center of the polar ray is larger than the background general corona and also van de Hulst's result. But outside 1.15R $\odot$, they are in fairly good agreement with each other. Polar rays with smaller width would have larger intensity gradient. Author

N65-33050*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
STUDIES IN THE FIELDS OF SPACE FLIGHT AND GUIDANCE THEORY Progress Report No. 7, 23 Jul. 1964–1 Apr. 1965
12 Jul. 1965 488 p refs
(NASA-TM-X-53292) CFSTI: HC $7.88/MF $2.50 CSCL 22C

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11. SOME NUMERICAL RESULTS OF GEOCENTRIC LOW THRUST TRAJECTORY OPTIMIZATION H. K. Hinz, R. Mc Gill, and G. Taylor (Grumman Aircraft Eng. Corp.) p 347–372 refs (See N65-33061 21-30)

12. COMPUTATION OF OPTIMAL INTERPLANETARY LOW-THRUST TRAJECTORIES WITH BOUNDED THRUST MAGNITUDE BY MEANS OF THE GENERALIZED NEWTON-RAPHSON METHOD P. Kenneth and G. E. Taylor (Grumman Aircraft Eng. Corp.) p 373–392 refs (See N65-33062 21-30)

13. APPROXIMATING OPTIMAL TRAJECTORIES: SELECTION OF SIGNIFICANT ESTIMATION VARIABLES IN A LEAST SQUARES PROBLEM I. E. Perlin, J. H. Mackay, J. W. Walker, J. J. Goode, and O. B. Francis, Jr. (Georgia Inst. of Tech.) p 393–488 refs (See N65-33063 21-30)

14. ON THE NUMERICAL REPRESENTATION OF THE GENERAL SOLUTION OF SYSTEMS OF ORDINARY DIFFERENTIAL EQUATIONS R. Silber (Southern Ill. Univ.) p 489–497 refs (See N65-33064 21-19)

N65-33052* Auburn Univ., Ala.

A MAXIMUM PRINCIPLE RE-ENTRY STUDY

Joe W. Reece and Grady R. Harmon *In* NASA. Marshall Space Flight Center Studies in the Fields of Space Flight and Guidance Theory 12 Jul. 1965 p 33–63 refs (See N65-33050 21-30) CFSTI: HC $7.88/MF $2.50

The Maximum Principle of Pontryagin is used to find the point-to-point re-entry trajectory of a space vehicle with an offset center of gravity which will minimize the accumulated aerodynamic acceleration. The mathematical model used incorporates the yaw angle and the true angle of attack as control variables. The set of characteristic differential equations is written with both algebraic and differential constraints. A computation procedure is devised so that numerical solutions can be obtained on a digital computer. Author

N65-33054* North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.

NUMERICAL INVESTIGATION OF MINIMUM IMPULSE ORBITAL TRANSFER Special Report No. 7

Gary A. Mc Cue and David F. Bender *In* NASA. Marshall Space Flight Center Studies in the Fields of Space Flight and Guidance Theory 12 Jul. 1965 p 89–121 refs (See N65-33050 21-30) CFSTI: HC $7.88/MF $2.50

(Contract NAS8-5211)

(SID-64-423)

A numerical optimization technique termed "adaptive steepest descent" is shown to overcome convergence difficulties encountered with other less powerful methods. A double-precision IBM 7094 program incorporating this technique was used to make detailed studies of complicated impulse function spaces associated with various orbit pairs which had been previously investigated by function contouring. Several interesting results, including the existence of at least three locally minimum two-impulse transfers between "almost tangent" coplanar elliptical orbits, were revealed by these numerical studies. Other numerical data indicates that minimum impulse transfer circumstances for coplanar orbits may be extended to strongly inclined orbits; that is, one and two-impulse maneuvers which are optimal exist for classes of inclined orbits. Results of a study of orbits which osculate to a Lawden Spiral are also presented. It was found that two-impulse transfers between these orbits always required less velocity change than a transfer between the points of osculation, along a Lawden Spiral. Extensive numerical comparison revealed that the difference in velocity change for the two maneuvers increases approximately as the 4.7 power of a parameter denoting distance between the points of osculation on the Lawden Spiral. Author

N65-33055* North American Aviation, Inc., Downey, Calif. Space Sciences Lab.

OPTIMAL ONE-IMPULSE TRANSFER BETWEEN COPLANAR ELLIPTICAL ORBITS Special Report No. 8

David F. Bender and Gary A. Mc Cue *In* NASA. Marshall Space Flight Center Studies in the Fields of Space Flight and Guidance Theory 12 Jul. 1965 p 123–153 refs (See N65-33050 21-30) CFSTI: HC $7.88/MF $2.50

(Contract NAS8-5211)

(SID-64-1859)

Numerical and analytical results concerning optimum one-impulse orbital transfer maneuvers are presented. By considering a class of "shallowly intersecting" coplanar orbits which may be produced by differentially changing the orbital elements of a pair of tangent orbits, one may derive a number of approximate expressions concerning the minima of the one-impulse maneuvers that occur. Numerical comparisons of one-impulse transfers and corresponding optimum two-impulse and optimum 180° two-impulse transfers were made. These comparisons suggested that there exists a narrow range of shapes over which one-impulse transfer is optimal and indicated analytical expressions bounding the region for the equivalence of one-impulse transfer and optimum 180 degree two-impulse transfer. Simple exact equations which define outer bounds to the range of shapes over which one-impulse may be optimal were then derived. Straight forward evaluation of these expressions immediately establishes the non-optimality of a one-impulse transfer between any given pair of coplanar orbits. Author

N65-33056* United Aircraft Corp., East Hartford, Conn. Research Labs.

OPTIMAL VARIABLE-THRUST RENDEZVOUS OF A POWER-LIMITED ROCKET BETWEEN NEIGHBORING LOW-ECCENTRICITY ORBITS Final Report

F. W. Gobetz *In* NASA. Marshall Space Flight Center Studies in the Fields of Space Flight and Guidance Theory 12 Jul. 1965 p 155–222 refs (See N65-33050 21-30) CFSTI: HC $7.88/MF $2.50

(Contract NAS8-11099)

(C-910098-12)

This study includes and extends previous work wherein only the case of transfer between circular orbits was considered. As before, the analysis is based on the assumption that only small deviations from an initial orbit are allowed. Complete analytical solutions are obtained in three different sets of variables: (1) rotating rectangular coordinates, (2) rotating spherical coordinates, and (3) Lagrange's planetary variables. In addition to the determination of optimal transfer and rendezvous trajectories in three dimensions, synthesis of the optimal controls is also carried out in each case. The guidance coefficients resulting from the control synthesis are presented both in graphical form and in equation form suitable for use in guidance applications. The use of an intermediate reference orbit is found to be a powerful method of improving the accuracy of the linearized theory. Results for circular, coplanar earth-Venus and earth-Mars transfers are compared with exact solutions. The linear theory is shown to provide a very good correlation with exact data for all trip times of interest. Author

N65-33058* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

NOTES ON THE RESTRICTED THREE BODY PROBLEM: APPROXIMATE BEHAVIOR OF SOLUTIONS NEAR THE COLLINEAR LAGRANGIAN POINTS

C. C. Conley *In its* Studies in the Fields of Space Flight and Guidance Theory 12 Jul. 1965 p 247–266 refs (See N65-33050 21-30) CFSTI: HC $7.88/MF $2.50

Linearized equations were developed to describe in some detail the geometry of solutions of the restricted three body problem (as viewed in the rotating coordinate system) near those equilibrium points which are collinear with the two positive masses. Qualitative observations which can be carried over to the nonlineer equations for suitable values of the Jacobi constant were also obtained. G.G.

N65-33059* Hayes International Corp., Birmingham, Ala.
ON AN APPLICATION OF THE HAMILTON-JACOBI THEORY TO HIGH THRUST ROCKET FLIGHT
A. A. Nafoosi and H. Passmore *In* NASA. Marshall Space Flight Center Studies in the Fields of Space Flight and Guidance Theory 12 Jul. 1965 p 267–296 refs (See N65-33050 21-30) CFSTI: HC $7.88/MF $2.50

The Hamilton-Jacobi theory was used to obtain solutions to both the zero gravity and the flat earth-constant gravity rocket flight problems. A first order approximate solution of the inverse square gravitational attraction problem was evolved, but a closed form solution to the inverse square problem was not found. G.G.

N65-33060* Hayes International Corp., Birmingham, Ala.
A FIRST ORDER DELAUNAY SOLUTION FOR MINIMUM FUEL, LOW THRUST TRAJECTORIES
Harry Passmore, III *In* NASA. Marshall Space Flight Center Studies in the Fields of Space Flight and Guidance Theory 12 Jul. 1965 p 297–345 refs (See N65-33050 21-30) CFSTI: HC $7.88/MF $2.50

This paper utilizes the similarity of the minimum fuel trajectory equations to those representing a restricted three-body problem to gain a canonical formulation in the variables of Delaunay. A two step transform procedure carried to the first order in small parameters is then presented as an indication of a method that may be followed in higher order studies. This progress report presents the analytical development of the procedure as completed through December, 1964. Author

N65-33061* Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
SOME NUMERICAL RESULTS OF GEOCENTRIC LOW THRUST TRAJECTORY OPTIMIZATION
Hans K. Hinz, Robert Mc Gill, and Gerald Taylor *In* NASA. Marshall Space Flight Center Studies in the Fields of Space Flight and Guidance Theory 12 Jul. 1965 p 347–372 refs (See N65-33050 21-30) CFSTI: HC $7.88/MF $2.50

The generalized Newton-Raphson method is used to determine optimum, coplanar, circle-to-circle, transfer trajectories for low thrust space vehicles operating in a strong central force field, such as a near earth orbit. Optimum thrust steering programs are computed for progressively increasing values of final time up to durations involving 26 revolutions about the earth. A description of the numerical results and a comparison of these with the results of a previous linear analysis are given. Author

N65-33062* Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
COMPUTATION OF OPTIMAL INTERPLANETARY LOW-THRUST TRAJECTORIES WITH BOUNDED THRUST MAGNITUDE BY MEANS OF THE GENERALIZED NEWTON-RAPHSON METHOD
Paul Kenneth and Gerald E. Taylor *In* NASA. Marshall Space Flight Center Studies in the Fields of Space Flight and Guidance Theory 12 Jul. 1965 p 373–392 refs (See N65-33050 21-30) CFSTI: HC $7.88/MF $2.50

The generalized Newton-Raphson method, an iterative procedure for solving nonlinear operator equations, has been extended in application to variational problems with bounded control variables. A minimum fuel interplanetary low thrust orbital transfer problem is worked out in detail to demonstrate the practical aspects of the algorithm as well as its computational effectiveness. The control variables are the thrust magnitude, limited from zero to some prescribed maximum value, and the thrust steering angle. Author

N65-33063* Georgia Inst. of Tech., Atlanta. Rich Computer Center.
APPROXIMATING OPTIMAL TRAJECTORIES: SELECTION OF SIGNIFICANT ESTIMATION VARIABLES IN A LEAST SQUARES PROBLEM
I. E. Perlin, J. H. Mackay, J. W. Walker, J. J. Goode, and O. B. Francis, Jr. *In* NASA. Marshall Space Flight Center Studies in the Fields of Space Flight and Guidance Theory 12 Jul. 1965 p 393–488 refs (See N65-33050 21-30) CFSTI: HC $7.88/MF $2.50
(Contract NAS8-5365)

In this report a step-up procedure for the selection of significant estimation variables in a least squares problem is developed. Application of this procedure to several examples is made, and a computer program in ALGOL 58 compiler language for the Burroughs 220 computer is discussed. Author

N65-33068# British Interplanetary Society, London (England).
A SPACE DEVELOPMENT PROGRAMME FOR EUROPE
L. R. Shepherd [1965] 12 p ref Presented at the 5th European Space Flight Symp. Submitted for Publication CFSTI: HC $1.00/MF $0.50

A twenty-year program for development of launch vehicles in Europe is outlined and discussed. It is expected that the core of this program will be the development of a series of three Europa vehicles. In the remainder of this decade, space missions will be restricted mainly to scientific satellites operating in close-orbits; at the same time it should be possible to launch experimental communications satellites and perhaps one or two spacecraft for deep space missions. The overall objective of this program is to establish European space research on a par with American and Soviet space research. J.M.D.

N65-33134*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ASTEROID BELT AND JUPITER FLYBY MISSION STUDY Final Report
D. J. Shapland et al 28 Feb. 1965 503 p Prepared for JPL
(Contracts NAS7-100; JPL-950871)
(NASA-CR-64621; M-49-65-1) CFSTI: HC $8.00/MF $2.50 CSCL 22A

A feasibility study of the use of unmanned spacecraft to investigate the asteroid belt, and of the use of these results as growth potential to formulate a Jupiter flyby mission, is reported. Detailed account is given of mission objectives, concepts, and methods of approach; status of knowledge of asteroid belts and Jupiter; the planning of experiments; trajectory and performance analysis; spacecraft systems designs and subsystem analysis; reliability analysis; program plan and cost for maximum missions; and description of maximum missions. A comprehensive survey of desirable scientific observations, experimental techniques, and instrumentation show that the most problematic mission would be the asteroid belt flythrough, and that highly specialized equipment must be designed. J.M.D.

N65-33178*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

THEORETICAL BASIS OF THE JPL ORBIT DETERMINATION PROGRAM

24 Mar. 1964 94 p

(NASA-CR-64786; JPL-TM-312-409) CFSTI: HC $3.00/MF $0.75 CSCL 22C

Formula derivations and computational techniques are included in a detailed description of the theoretical basis of an orbit determination program. Included are discussions of the estimation formula, parameter covariance matrix, and mapping covariance matrix for a statistical model; observable computations of range, range rate, angles, time of occulation, and Doppler data; observable corrections for light time, local vertical corrections, refraction, and aberration; and regression coefficients for variations in accelerations and observables, and inversion of the state transition matrix. R.N.A.

N65-33187*# Harvard Coll. Observatory, Cambridge, Mass.

A CRITICAL ANALYSIS OF LUNAR TEMPERATURE MEASUREMENTS IN THE INFRARED Scientific Report No. 6

Hector C. Ingrao, Andrew T. Young, and Jeffrey L. Linsky 15 Apr. 1965 146 p refs

(Grant NsG 64-60)

(NASA-CR-64798) CFSTI: HC $4.00/MF $1.00 CSCL 03B

Data from radiation pyrometer measurements of the lunar brightness temperature during the total lunar eclipses of June 24-25, and of December 18-19, 1964 were evaluated. Numerical integration of the heat-flow equation for several lunar surface models showed a low accuracy of infrared brightness temperature measurements during eclipse. It was found that: (1) The eclipse observations do not correspond with a model having a homogeneous surface material with temperature-independent thermal properties; (2) Eclipse observations of the crater Tycho are consistent with models having two-layer temperature-independent thermal properties; and (3) different models can have similar surface temperatures during an eclipse, which differ by 10°K or more at depths of several millimeters. It was concluded that homogenous models with linearly temperature-dependent thermal properties, and models including a radiative transfer term, correspond better with the lunation data. G.G.

N65-33188*# Philco Corp., Palo Alto, Calif. Western Development Labs.

COMET AND CLOSE APPROACH ASTEROID MISSION STUDY Final Report

Frank Elsbree, G. O. Moore, Reece Jensen, and John Savides [1965] 30 p Prepared for JPL

(Contract JPL-950870)

(NASA-CR-64799) CFSTI: HC $2.00/MF $0.50 CSCL 22A

The material used to study comet and close approach asteroid missions is graphically presented. Mission objectives and study approach are defined, and figures depict a comet model, heliocentric transfer geometry, parking orbit launch geometry, data on the Pons-Winnecke comet, schematic of comet mission events, the total panel area vs. heliocentric distance, radioisotope thermoelectric power generators for space vehicles, and comet probe configurations. Tabulations show data on a preliminary comet survey, comet positional uncertainties at perihelion, comet recovery, comet and asteroid experiments, telecommunication hardware, and Mariner-C modifications for comet probes. Program costs and major milestones in the program are also depicted. R.W.H.

N65-33212*# National Aeronautics and Space Administration, Washington, D. C.

GEMINI 5 REVIEW BEFORE THE NATIONAL ACADEMY OF SCIENCES News Release

Hubert H. Humphrey, James E. Webb, Hugh L. Dryden, Frederick Seitz, Harry Hess et al 14 Sep. 1965 44 p Available from the Scientific and Technical Information Division CSCL 22A

Personal accounts of the eight-day flight of Gemini V are given by astronauts Gordon Cooper and Charles Conrad. Data on human physiological reactions to space flights of extended duration, drawn from laboratory experiments and the GT-4 and GT-5 space flights, are summarized and discussed by Dr. Charles Berry, senior physician in the Gemini project. J.M.D.

N65-33227# Royal Aircraft Establishment, Farnborough (England).

A LIST OF THE PEGASUS PROGRAMMES CONCERNED WITH SATELLITE ORBITAL DYNAMICS

R. J. Tayler [1964] 19 p refs

(RAE-TM-SPACE-62; AD-465627)

A number of Pegasus computer programs covering a variety of problems involved in satellite orbital dynamics are presented. Programs are included on general astronomy, conversions of orbital parameters between different systems, orbit determination, prediction and evolution of orbits, satellite ephemerides and perturbations, gravitational potential, observing stations, and tracking and coverage of communications satellites. R.N.A.

N65-33258*# New Mexico State Univ., University Park. Observatory.

PROVISIONAL TOPOGRAPHIC MAP OF MARS, MARINER 4 REGION

Clyde W. Tombaugh Jul. 1965 15 p refs

(Grant NsG-142-61)

(NASA-CR-64772; TN-701-66-8) CFSTI: HC $1.00/MF $0.50 CSCL 03A

A provisional topographic map of the portion of the surface of Mars is presented and explained that the Mariner 4 is expected to photograph. Also included is a summary interpretation of the appearance and nature of the various features of the Mars surface from 37 years of telescopic observations. These interpretations were used as criteria for making a topographic breakdown of the map into ten levels. G.G.

N65-33278*# Wyoming Univ., Laramie. Natural Resources Research Inst.

PROPOSED NAUTICAL UNITS OF LENGTH AND TIME Technical Report No. 2

John C. Bellamy Apr. 1965 22 p refs

(Grant NsG-658)

(NASA-CR-64807) CFSTI: HC $1.00/MF $0.50 CSCL 22C

Some newly conceived units of length and time are proposed to facilitate the coordination of space-time positions in orbital operations. These units are defined as specific numerical multiples of primary standard units of length and time. Nautical feet, yards, chains, miles, degs, quads, and circs are characteristic of distances associated with angular measures of position and time on the surface of the earth. The nautical rad, defined with a commensurate counterpart of pi to be 3437.75 nautical miles, is characteristic of distances from the center of the earth to its surface. The nautical day, hour, minute, and second, defined so that exactly 366.25 nautical days are contained in a Julian year, are characteristic of the rotation of the earth with respect to both the equinox and the stars. These nautical units are useful for intercoordinating angular and linear horizontal coordinates: coordinates fixed to the earth, equinox, and stars; and geometric, barometric, and chronometric vertical coordinates. C.T.C.

N65-33287*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ORBIT DETERMINATION
Joseph W. Siry [1965] 15 p
(NASA-TM-X-56783) CFSTI: HC $1.00/MF $0.50 CSCL 22C

Analysis of satellite orbital tracking data yielded new information concerning air densities and the shape of the earth, and accurate measures of the oblateness of the earth were obtained. A number of new and important discoveries were made concerning the earth's atmosphere, using orbital data. It was found that the atmosphere bulges on the side of the earth which faces toward the sun. The bulge effect is greatest in longitudes that correspond to the early afternoon hours. This was discovered by observing that the satellite orbital period decrements, and hence the corresponding atmospheric densities, increased as the perigees of elliptical satellite orbits moved from the dark side of the earth around toward the bulge. In addition, it was observed that the atmospheric density increased rather sharply shortly after certain types of solar flares were observed to occur on the sun. R.W.H.

N65-33442# Smithsonian Astrophysical Observatory, Cambridge, Mass.
A TWO-DIMENSIONAL QUANTITATIVE SPECTRAL CLASSIFICATION OF 23805-B7 STARS AND THE CONSTRUCTION OF A SPECTRUM-ABSOLUTE MAGNITUDE DIAGRAM
I. M. Kopylov 22 Jul. 1965 76 p refs Transl. into ENGLISH from the Ann. of the Crimean Astrophys. Obs., v. 20, 1958 p 156-207 *Its* Astron. Papers Transl. from the Russ. No. 5

From the catalog of equivalent widths in the spectra of 238 05-B7 stars, quantitative criteria have been established for the determination of spectral type and absolute magnitude. The probable error of a spectral class of a star is in the mean ±0.14 and ±0.28 of one spectral subclass, for stars of earlier and later spectral class than B3, respectively. The mean probable error of an absolute magnitude for all the stars is $\pm 0^{m}.10$, the error being larger than $0^{m}.25$ for only five percent of the stars. The derived systems of spectral classes and absolute magnitudes of 05-B7 stars were compared with the systems of other authors, in particular with the Petrie system of absolute magnitudes and the system (D, λ_1-3700). The spectrum-absolute magnitude diagram is discussed. The distance moduli were found for five galactic clusters and associations, using the derived M. The "line of zero age"—the main sequence for stars for which gravitational contraction has just ended—was found. Author

N65-33446# Dynalectron Corp., Point Magu, Calif. Paradyn Div.
COMPUTATIONAL PROCEDURE AND COMPUTER PROGRAMS FOR IZSAK'S ANALYTIC SATELLITE ORBIT
W. E. Knolle and W. A. Allen May 1964 75 p refs
(Contract N-123(61756)-19425A)
(Rept.-44; AD-461851)

I. G. Izsak obtained an analytic solution for a satellite orbit by replacing the potential of the Earth with Vinti's potential. The solution contains six arbitrary constants of integration. Added to this solution are perturbation terms derived by I. G. Izsak. The report deals with the computational procedures connected with this model of a satellite orbit. The procedures are: Fitting of the orbit model to initial conditions; fitting of the orbit model to a number of orbit points; impact prediction for free-flight rocket trajectory; comparison of orbit model with numerically integrated orbit; listing of FORTRAN IV computer programs for the IBM 7094. Author

N65-33474# Brandeis Univ., Waltham, Mass.
A COMPUTER MODEL FOR PLANETARY NEBULAE Scientific Report No. 1
Murray Turoff (Inst. for Defense Anal., Va.) Feb. 1965 124 p
(Contract AF 19(628)-4019)
(AFCRL-65-223; AD-619205)

A treatment of the planetary nebulae problem in which a computer model is constructed that will produce a consistent solution for such variables, within the nebular shell, as the radiation field, electron temperature, ionization densities, and expansion velocities of the elements. The nebula is characterized by such parameters as the average density of particle, average expansion velocity, size, relative abundances, and temperature of the central star. An equal measure of treatment is provided the three physical problem areas associated with planetary nebulae: radiative transfer, gas dynamics, and gas structure. The problem is treated in as much detail and accuracy as is consistent with both available computers and inherent observational inaccuracies. Author

N65-33485# Martin Co., Denver, Colo.
TECHNIQUE FOR EVALUATING SPACE-VEHICLE DOCKING MECHANISMS
W. L. De Rocher, Jr. and A. E. Wudell Nov. 1964 125 p refs
(R-64-7; AD-462140)

An experimental after-contact coupling study was performed on the rendezvous, closure, and docking simulator. This technique used a mechanical positioning of the docking device on Vehicle 1 with respect to a fixed vehicle, by a 6 degree-of-freedom servo-driven carriage. Intervehicular forces and moments were measured by seven load cells mounted at a dividing plane in the fixed vehicle. These forces and moments were fed into a 12 degree-of-freedom analog simulation of the motion equations of the two vehicles. A prototype docking device was also evaluated. A ring was used on one vehicle; a set of four movable arms, fitted with mechanically triggered hooks, was used on the other. These hooks move down the arms to catch the ring; pneumatically controlled struts connected to each arm absorb the shock and draw the two vehicles together. Preliminary results indicate that the evaluation technique and the docking device are feasible. M.G.J.

N65-33499# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center.
SATELLITE ORBIT DETERMINATION, A BIBLIOGRAPHY
Dale Denham Jun. 1965 126 p refs
(RSIC-415; AD-468532)

The cited references pertain to the area of "Satellite Orbit Determination." This bibliography covers the following: (1) Methods to use and combine tracking data from radar and other tracking systems for orbit determination, and (2) The influence of tracking station location, number of stations, and time of tracking on the accuracy of orbit determination. In addition to the above, the cited references cover analysis and simulation of orbits; mathematics and parameters of orbits; theory and techniques; prediction and accuracies; programming and computers; error analysis; evaluation of ground coverage; systematic errors; airborne platforms; space dynamics; self-contained orbit determination techniques; and space-time. This bibliography consists of four sections: Section I–Introduction. Section II–Orbit Determination, Entries 1 through 161. Section III–Programs and Satellite Systems, Entries 162 through 187. Section IV–Equipment and Facilities for Orbit Determination, Earth-Based, Entries 188 through 253. Author

N65-33520# Aeronautical Chart and Information Center, St. Louis, Mo.
THE OSCULATING H-FRAME: A NEW ANALYTICAL TECHNIQUE IN ORBITAL DYNAMICS
James A. Jungmann May 1965 50 p refs
(ACIC-TP-17; AD-617167)

The H-Frame, $\vec{i}_H$, $\vec{j}_H$, $\vec{k}_H$, is a right-handed orthogonal unit vector triad which originates at the center of mass of the vehicle. The $\vec{i}_H$ axis lies along the projection of the total velocity vector on the local horizontal plane and the $\vec{k}_H$ axis points "down" along (and opposite in sense to) the radius vector. The $\vec{j}_H$ axis completes the system. The three-degree-of-freedom (point mass) equations of motion for a space vehicle with respect to a gravitating mass are derived first in terms of the H-Frame. Utilizing Lagrange's variation of parameters method, the rates of change of the H-Frame-referenced orbital elements are determined as functions of the perturbation forces (forces other than central gravitational). The technique is then applied to three specific problems wherein the intrinsic advantages become more apparent–the motion of a vehicle in earth orbit, a cislunar trajectory, and the low-thrust powered flight of an interplanetary spacecraft. Author

N65-33529# Royal Greenwich Observatory, Herstmonceux (England).
RESULTS OBTAINED WITH A DANJON ASTROLABE AT HERSTMONCEUX. I: OBSERVATIONS
D.V. Thomas London, HMSO, 1965 72 p refs *Its* Bull. No. 92
CFSTI: HC $3.00/MF $0.75

The results of four years' observations with a Danjon astrolabe at Herstmonceux are being published in two parts. This Bulletin, Part I, contains a description of modifications made to the instrument, details of the method of operation and of the observing programme, and the theory and method of the reduction of the observations. The observed values of time, latitude and prism angle are tabulated for the complete series of observations. Author

N65-33530# Royal Greenwich Observatory, Herstmonceux (England).
INVESTIGATION OF PROPER MOTIONS IN THE FIELD OF THE CLUSTER M 67. I: THE CENTRAL REGION
C. A. Murray, P. M. Corben, and Mary R. Allchorn London, HMSO, 1965 39 p refs *Its* Bull. No. 91 CFSTI: HC $2.00/MF $0.50

Discussed are proper motions of nearly 500 stars in the field of the cluster M 67, derived from plate-pairs taken by a 26-inch refractor, and with a 60-inch reflector. The survey is complete to $B = 16^m5$ in an area $27' \times 27'$ near the cluster center. Distances of field stars in the color range $0^m.5 \leq B\text{-}V < 0^m8$ have been computed, and their velocity ellipse is in good agreement with that for the G dwarfs in the solar neighborhood. The period of oscillation through the galactic plane, based on Oort's value of K_z, was established as 89×10^6 years, and the velocity perpendicular to the plane at $z = 0$ as 36 km/s. Color-magnitude diagrams for cluster members, based on photoelectric and photographic photometry, showed marked differences in the luminosity function in different annuli centered on the cluster. The composite diagram for the whole cluster, compared with the zero-age main sequence, produced no evidence of evolutionary effects below $V = 14^m$. G.G.

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N65-32572*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A THEORETICAL INVESTIGATION OF THE ROLLING MOTION OF THE NIKE CAJUN AND NIKE APACHE ROCKET VEHICLES
Roger J. Hawks (B.S. Thesis—Cincinnati Univ.) Aug. 1965 31 p refs
(NASA-TM-X-55282; X-721-65-335) CFSTI: HC $2.00/MF $0.50 CSCL 22B

An attempt has been made to theoretically predict the roll rate of the second stage of the Nike Cajun and Nike Apache sounding rocket vehicles. The one-degree-of-freedom roll equation was derived. General expressions were obtained for the roll damping coefficient derivative of a sounding rocket in both subsonic and supersonic flight. Analytic expressions for the roll forcing moment coefficient due to fin trailing-edge wedges are presented for the subsonic and supersonic flight regimes. These equations have been applied to the Cajun and Apache vehicles and the results compared to wind tunnel and free-flight test results. The roll damping coefficients are in excellent agreement with wind tunnel results, but the roll forcing coefficients do not agree. Neither the theoretical nor the wind tunnel forcing coefficients gave a roll history as obtained in free-flight tests. The theoretically predicted roll history does, however, show several previously unexplained characteristics of the free-flight roll history. Author

N65-32594*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INTERPLANETARY MONITORING PLATFORM, IMP I EXPLORER XVIII Second Interim Status Report
Frank A. Carr Jul. 1965 49 p refs
(NASA-TM-X-55277; X672-65-299) CFSTI: HC $2.00/MF $0.50 CSCL 22B

The IMP I spacecraft operated continuously and sucessfully for more than 6 months. Intermittent operation began on 30 May 1964 due to a malfunction of the spacecraft battery. In May, 1965 all efforts to acquire further data were terminated since the satellite was only operating for a few minutes each day. The highly elliptical orbit provided the 9 scientific experiments with a unique opportunity to examine the outer limits of the Earth's magnetosphere, the transition region, and interplanetary space. With a few exceptions the experiments operated properly, returning nearly 6000 hours of scientific information. The performance of the telemetry, power, and thermal systems was near normal and is discussed based on telemetered performance parameter data. On 6 May 1964, the satellite entered the shadow of the earth which plummeted the temperature of experiments and systems to −40° C and below, while solar paddles and other exterior parts reached about −150° C. The satellite survived the longest known shadow and cold environment to which any spacecraft has been exposed. R.N.A.

N65-32595*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INTERPLANETARY MONITORING PLATFORM IMP II—EXPLORER XXI Flight Report

Aug. 1965 37 p refs
(NASA-TM-X-55281; X-724-65-340) CFSTI: HC $2.00/MF $0.50 CSCL 22B

IMP II was launched on October 3, 1964 from Cape Kennedy, Florida, by the Delta 26 Launch vehicle. The apogee achieved was 51,600 n.m., which was less than one-half of the planned altitude. This problem was attributed to the suspected failure of the igniter assembly of the third-stage motor, occurring after about 16 seconds of normal burning. The angle between the spacecraft spin-axis and the ecliptic plane was reduced by the third-stage malfunction, resulting in a wider range of incident sun-angles during the satellite lifetime. This caused low power output from the solar paddles and over-heating of the silver-cadmium battery. Spacecraft performance was satisfactory until the +50° C temperature environment (about two months after launch) caused the failure of the battery. Thereafter, the spacecraft operated only during periods of favorable incident sun-angles. In all, about five months of useful data was recorded. As of mid-1965, the spacecraft was operating intermittently with essentially no useful data being obtained. There is some possibility that perhaps as much as a month's more data might be obtained in the future. Author

N65-32599*# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
MANNED MARS AND/OR VENUS FLYBY VEHICLE SYSTEMS STUDY. VOLUME 5: RELIABILITY ANALYSIS Final Report
A. L. Jones and W. V. Mc Rae, Jr. Jun. 1965 228 p refs
(Contract NAS9-3499)
(NASA-CR-65122; SID-65-761-5) CFSTI: HC $6.00/MF $1.25 CSCL 22B

An extended reliability/maintainability analysis of the life support and environmental control subsystems for the Mars and Venus flyby vehicle was performed. The phases after interplanetary injection and prior to recovery were studied. Evaluated were systems for: (1) Mars flyby with a goal of 0.97 success probability; (2) Mars flyby with a goal to equalize risk at $P_R \geq 0.999$; and (3) Venus flyby, using the equalized risk (0.999) flyby system plan but with solar cells for electrical power source. A probability of safe return estimate of 0.9968 was found for the Venus mission as opposed to 0.991 for the Mars mission under the same departure conditions. A raise of the P_R would more than double the spares weight required, because the gain for unit weight of spares is small after the failure hazard has been equalized. G.G.

N65-32703*# Massachusetts Inst. of Tech., Cambridge.
DYNAMICS OF A SOLAR PRESSURE STABILIZED SATELLITE
John Raymond Carroll and Robert Charles Limburg (M.S. Thesis)
Jun. 1965 74 p refs
(Contract NASr-249)
(AD-617517)

It is the objective of this thesis to investigate the body dynamics of a solar pressure stabilized satellite in a heliocentric orbit of nonzero eccentricity. The equations of motion for an unsymmetrical satellite are simplified by finding satellite equilibrium position and making small angle assumptions about this position to linearize the equations. The motions predicted by the simplified model are compared with digital computer solutions of the general equations of motion. Passive damping and injection of the satellite into orbit are investigated briefly. In its equilibrium position, the satellite has one principal axis along the radial line. Of the two remaining principal axes, the one with the greater moment of inertia is perpendicular to the orbital plane. For the simplified model, motion about the three principal axes can be uncoupled for small disturbances from equilibrium. Motion about the radial line is characterized by oscillations at approximately orbital frequency rate. Author

N65-32720*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
CATALOG OF SATELLITE OBSERVATIONS, NO. C-42
Beatrice Miller 7 May 1965 81 p
(Grant NsG-87-60)
(NASA-CR-64470; SAO Special Rept.-179) CFSTI: HC $3.00/MF $0.75 CSCL 22C

A catalog of satellite observations is presented on the Anna 1B, Injun 3, Relay 1, Explorer XVII, Cosmos 14, Telstar 2, Geophysics Research satellite 26A, and satellite 30D. The data given list month, day; time in hours, minutes, and seconds; right ascension in hours, minutes, and seconds; declination, azimuth, and altitude in degrees, minutes, and seconds; azimuth measured from north through east; and range in kilometers. R.N.A.

N65-32722*# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
STUDY OF A SMALL SOLAR PROBE (SUNBLAZER). PART II: SPACECRAFT AND PAYLOAD DESIGN Progress Report, Jul. 1, 1964–Jun. 30, 1965
R. H. Baker, S. Cohen, W. W. Cooper, D. H. Galvin, J. V. Harrington et al 1 Jul. 1965 109 p refs
(Grant NASr-249)
(NASA-CR-64459; PR-5255-5) CFSTI: HC $4.00/MF $1.00 CSCL 22B

Design considerations for the Sunblazer solar probe and its payload are discussed. Specific design aspects include the spacecraft mechanical structures, thermal characteristics, dynamics, power generator and control, radio frequency electronics, Barker code generator, digital circuitry, telemetry, beacon telemetry, and a system description of the receiver and detector. Calculations of the thermal transfer and radiation from a thin circular plate source and a thin cylindrical shell radiator, which are shell configurations in the Sunblazer satellite, are included in the appendix. R.N.A.

N65-32757*# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
STUDY OF A SMALL SOLAR PROBE (SUNBLAZER). PART I: RADIO PROPAGATION EXPERIMENT
J. V. Harrington 1 Jul. 1965 53 p refs
(Contract NASr-249)
(NASA-CR-64454; PR-5255-5) CFSTI: HC $3.00/MF $0.50 CSCL 22B

Radio propagation experiments for the Sunblazer project are discussed. For reasonable models of the electron density distribution in the corona, the relative delay between signals transmitted on frequencies of 100 and 300 MC on long paths displaced from the solar center from two solar radii to 100 solar radii varies from 100 milliseconds to 300 microseconds and are readily measurable. The most desirable heliocentric orbit is one with perihelion at 0.53 A.U. and a sidereal period of 0.667 years. This permits conjunction to occur in one year on the line of apses and gives a mirror geometry of the transmission path before and after conjugation. Pulse splitting produced by ordinary-extraordinary mode propagation offers the best opportunity to make quantitative measurements of the general magnetic field of the sun. Magnetoionic effects produced by the corona will not dominate those produced by the terrestrial ionosphere until the path displacement is

less than 10 solar radii. A full size model of the spacecraft containing the necessary power supply, transmitters, and antennas was constructed. R.N.A.

N65-32761# Joint Publications Research Service, Washington, D. C.
STRUCTURE OF THE D-1 SATELLITE
1 Sep. 1965 8 p Transl. into ENGLISH from Air et Cosmos (Paris), no. 114, 17 Jul. 1965 p 14–15, 46
(JPRS-31798; TT-65-32293) CFSTI: $1.00

Described is the structure and instrumentation of a proposed lightweight French satellite that will use honeycomb material structures to achieve minimum weight for a given degree of strength. This satellite will be used in telemetering and remote control of the Diane and Iris radar networks; for orbital calculations from interferometric and Doppler data; for testing of an ultra-stable oscillator; and to obtain information on the behavior of the most important systems and operations on board of the rocket during space flight. G.G.

N65-32869*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ELECTROSTATIC CHARGING AND DISCHARGING MODELS AND ANALYSIS FOR RANGER SPACECRAFT DURING LAUNCH
George I. Cohn 1 Aug. 1965 40 p refs
(Contract NAS7-100)
(NASA-CR-64632; JPL-TR-32-771) CFSTI: HC $2.00/MF $0.50 CSCL 22B

An investigation designed to determine whether the electrical pulses induced in the payload circuitry by charging or discharging processes are sufficiently large to (1) actuate any device when it should not be actuated, or (2) cause any device not to be actuated when it should be, is reported. Charging and discharging phenomenologies were examined to provide the basis for the construction and analysis of approximate equivalent circuits. The pertinent properties of the induced electrical pulses were graphed against the circuit parameters, charging current, and breakdown voltage to facilitate extraction of numerical values. A preliminary analysis was also made of the charging current. Further studies are recommended to determine the actual values of charging current, breakdown voltage, and circuit parameters. S.C.W.

N65-32872*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
CONTROL FACTORS FOR APOLLO-SATURN 201 VEHICLE
Billy W. Nunley 19 Jul. 1965 45 p refs
(NASA-TM-X-53296) CFSTI: HC $2.00/MF $0.50 CSCL 22B

This report presents the control factor data to be used for Apollo-Saturn 201 vehicle control studies. Included are angular velocities, linear velocities, angular accelerations, and linear accelerations due to engine and aerodynamic forces. Also included are three-sigma variations of the more important control factors for the standard eight-engine case; i.e., no engine-out conditions were studied. Author

N65-32879*# National Aeronautics and Space Administration, Washington, D. C.
ATTITUDE STABILIZATION OF SATELLITES BY MEANS OF THE FREE REACTION SPHERE [LAGESTABILISIERUNG VON SATELLITEN MIT DER REAKTIONSSCHWONGKUGEL]
H. Schropl Jul. 1965 27 p Transl. into ENGLISH of paper presented at Ann. Meeting of Wiss. Ges. für Luft- und Raumfahrt/Deut. Ges. für Raketentechnik und Raumfahrtforsch., Berlin, 14–18 Sep. 1964
(NASA-TT-F-9513) CFSTI: HC $2.00/MF $0.50 CSCL 22B

Discussion of problems arising in the application of the free reaction sphere as a control element in the attitude stabilization of a satellite. Specifically examined are: the selection of the type of bearing for the sphere, the determination of the rotor dimensions, the selection of a propulsion system capable of applying torques to a rotor about any axis, and the measurement of rpm. An experimental device proposed for use in a satellite is described and illustrated. Author

N65-32889# Eurospace, Paris (France).
LAUNCHING FROM AIRCRAFT Eurospace Memoranda No. 4
Feb. 1965 26 p refs CFSTI: HC $2.00/MF $0.50

In assessing aircraft and rocket combinations for launching payloads into earth satellite orbits, three systems were examined: (1) the Hawker Siddeley Vulcan with a variety of rocket vehicles giving a maximum of 650 lb in orbit; (2) a scheme for launching meteorological vertical sounding probe rockets from small aircraft; and (3) U.S. F-100 series fighters to launch payloads of 20 to 100 lb. Feasibility studies of Vulcan-launched rockets were conducted and a comparison made between solid propellant and liquid propellant vehicles. Methods of adapting existing rockets were also considered. Results show that the scheme under which a Vulcan can launch a 3-stage solid or liquid rocket with 650 lb payload offers long term usefulness extending into the 1970's. Use of already developed rocket stages may reduce development costs. M.G.J.

N65-32955*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
STRUCTURES FOR SMALL SCIENTIFIC SATELLITES
Jesse M. Madey and Robert C. Baumann 7 Jul. 1965 126 p refs
(NASA-TM-X-55285; X-670-65-279) CFSTI: HC $4.00/MF $1.00 CSCL 22B

Among the design considerations are such items as schedule preparation, determining the basic shape of the satellite, launch vehicle–satellite compatibility, accessibility, materials, thermal design factors, RF design factors, structural loads, fabrication, integration, test, shipping and handling, and field operations. Author

N65-32957*# National Aeronautics and Space Administration, Washington, D. C.
AUTOMATIC CONTROL OF GUIDED MISSILES
Yu. P. Dobrolenskiy, V. I. Ivanova, and G. S. Pospelov Apr. 1965 551 p refs Transl. into ENGLISH of the book "Avtomatika Upravlyayemykh Snaryadov" Moscow, Oborongiz, 1963 p 1–548
(NASA-TT-F-9378) CFSTI: HC $8.50/MF $2.75 CSCL 22D

This book is concerned with the automatic control of guided missiles. The problems associated with the automatic control of guided missiles of various classes are solved by the application of engineering design methods developed by the theory of automatic control for linear and nonlinear dynamic systems. Various principles are considered for obtaining control signals using different methods of tracking. The fundamentals of missile control dynamics and typical control systems are described. Analytical expressions are presented for designing tracking systems and for determining the errors of these systems. The book is designed to serve as a textbook for university students. At the same time it will be useful to engineers and technicians who specialize in the field of the automatic control of guided missiles. Author

N65-33048# British Aircraft Corp., Stevenage (England). Guided Weapons Div.
PROGRESS WITH U.K.3
J. L. Blonstein and B. Stockwell 1965 53 p refs Presented at the 5th European Space Symp., Munich, Jul. 1965 CFSTI: HC $3.00/MF $0.50

Progress within the development program for the U.K. 3 Satellite is reported. Design alterations included replacement of the rod antennas by twin loop antennas mounted at the top of the satellite; modifications in shape and positioning of the sensor booms; and adoption of a boom-tip erection damping system for speed control. The experimenters' requirements in terms of altitude, orbital inclination, and launch window were evaluated, and a proposed target orbital altitude of around 500 km at an inclination of about 81° was established. The first two satellite bodies are currently undergoing tests for mechanical purposes and for electrical compatability trials. Associated ground checkout equipment is being built, and one ground support trailer is now in working condition. G.G.

N65-33114 Committee on Space Research (COSPAR), The Hague (Netherlands).
RESONANCE PROBE
K. Hirao and T. Muraoka *In its* Sounding Rocket Res. Tech. 1964 p 137-145 refs (See N65-33105 21-13) CFSTI: HC $5.00/MF $1.00

A new type of resonance probe is described. Electronic principles; electrical connection diagrams; functions of the electrical components and elements; mechanical construction of the instrument, measuring, and power supply sections; nose cone configurations; electrical output; and data reduction of the resonance probe are discussed. R.N.A.

N65-33115 Committee on Space Research (COSPAR), The Hague (Netherlands).
STANDING WAVE IMPEDANCE PROBE
J. C. Ulwick, W. Pfister, O. C. Haycock, and K. D. Baker *In its* Sounding Rocket Res. Tech. 1964 p 145-152 refs (See N65-33105 21-13) CFSTI: HC $5.00/MF $1.00

A standing wave impedance probe for measuring electron density is described. Its principle of operation and the electronics of its oscillator, RF switch and mode multivibrator, artificial lines, quadrupler rectifier, sawtooth generator, antenna network, telemetry requirements, antenna indicators, and power requirements are discussed. Mechanical details are included on the probe's electronic construction and antenna, and environmental considerations, calibration and pre-flight checks, data recording and reduction, and the interpretation of impedance data are discussed. R.N.A.

N65-33179*# Fairchild Stratos Corp., Bay Shore, N. Y.
RANGER 6-9 SPACECRAFT RELIABILITY STUDY Final Report
11 Nov. 1964 422 p refs Prepared for JPL Revised
(Contract JPL-950410)
(NASA-CR-64787) CFSTI: HC $7.00/MF $2.25 CSCL 22B

An analytical reliability model was developed to consider the 11 major systems of Ranger Spacecrafts VI through IX during five phases of flight and for four alternate missions. Data from failure effects analyses of each essential subsystem function provided the basis for the model; and six different failure categories, from comple to failure to negligible effects, were defined. Details of these analyses are included in an appendix as are reliability matrices and failure categories by mission. Configuration analyses led to the establishment of trade-off relationships from performance, reliability, cost, weight, and other design parameters. The analytical model is discussed in terms of spacecraft bus, television camera system, and computer program. M.W.R.

N65-33223*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOLUME 5, NO. 15
15 Aug. 1965 47 p
(NASA-TM-X-56769; X-537-65-217) CFSTI: HC $2.00/MF $0.50 CSCL 22B

N65-33450*# National Aeronautics and Space Administration, Washington, D. C.
MANNED SPACE FLIGHT, PROJECT APOLLO
[1965] 12 p
(NASA FACTS, Vol. III, No. 1) GPO: $0.15 CSCL 22B

Goals of the Apollo Project and the technique of orbital rendezvous are discussed in a fact sheet. Aspects of the Apollo spacecraft considered are the command, service, and lunar modules; the launch escape tower; the adapter; and guidance and navigation. Astronaut training and clothing, launch vehicles, unmanned moon probes, moon flight tracking, and lunar landing are mentioned. Lunar astronaut experiments are summarized, and Apollo follow-on programs are considered. M.W.R.

N65-33549*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
DESIGN AND OPERATIONAL CHARACTERISTICS OF A LUNAR-LANDING RESEARCH VEHICLE
Donald R. Bellman and Gene J. Matranga Washington, NASA, Sep. 1965 52 p refs
(NASA-TN-D-3023) CFSTI: HC $2.00/MF $0.50 CSCL 22B

The significant technical details and research capabilities of a free-flight lunar-landing simulator, as they existed at the time of the initial flights, are presented. The lunar-landing research vehicle (LLRV) consists of a pyramid-shaped structural frame with four truss-type legs. A pilot's platform extends forward between two legs, and an electronics platform is similarly located, extending rearward. A jet engine is mounted vertically in a gimbal ring at the center of the vehicle. The data obtained are converted to digital form and transmitted to a ground tape recorder by means of an 80-channel pulse-code-modulation type (PCM) telemetry system. Each channel can be read every 0.005 second, if desired. Many safety features are incorporated in this vehicle. The attitude-rocket system and the associated electronics are dualized. The jet engine has sufficient thrust to support the entire weight of the vehicle. In case of failure, a combination of normal lift rockets, emergency lift rockets, and a drogue parachute can be used to effect a landing. R.W.H.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N65-32395*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A METHOD OF DETERMINING MODAL DATA OF A NON-UNIFORM BEAM WITH EFFECTS OF SHEAR DEFORMATION AND ROTARY INERTIA
Vernon L. Alley, Jr., Robert J. Guillotte, and Lessie D. Hunter Washington, NASA, Sep. 1965 41 p refs
(NASA-TN-D-2930) CFSTI: HC $2.00/MF $0.50 CSCL 20K

A recurrence solution including the secondary effects of rotary inertia and shear deformation on discontinuous non-uniform beamlike structures is presented for obtaining highly descriptive free-free natural mode data. Results of other studies are included to ascertain the significance of the secondary influences on the classical uniform beam. Numerical results are also included for the application of the method to a first-stage configuration of a typical space research launch vehicle. The numerical results indicate that shear deformation is generally the prime contributor of the secondary effects on typical launch vehicle configurations; the major influences of the secondary effects are seen in reductions in natural frequencies and in changes to the mode slopes, mode moments, and mode shears. Author

N65-32402 Union Carbide Nuclear Co., Oak Ridge, Tenn. Y-12 Plant.
BLAST RESISTANT DESIGN
Richard C. Gwaltney *In its* Compendium of Gas Autoclave Eng. Studies 23 Aug. 1965 p 55–97 refs (See N65-32400 21-15) CFSTI: $6.00

A method is given for calculation of the stresses induced in reinforced concrete structures by impulsive loading such as shock waves in air. The method is based on the calculation of the deflection of the structure under shock loading, which is used to determine the magnitude of stresses acting in the structure. The procedure is illustrated in connection with experimental data on concrete wall sections exposed to blasts by 50-pound TNT charges. J.M.D.

N65-32403 Union Carbide Nuclear Co., Oak Ridge, Tenn. Y-12 Plant.
MODIFIED NEWMARK ANALYTICAL METHOD FOR BLAST-RESISTANT CALCULATIONS
C. E. Muzzall *In its* Compendium of Gas Autoclave Eng. Studies 23 Aug. 1965 p 99–132 refs (See N65-32400 21-15) CFSTI: $6.00

The original Newmark method of analysis, which involves the calculation of a static-equivalent pressure for a shock wave in terms of peak pressure and duration, has been modified for calculation in terms of impulse. This refinement permits a more accurate estimate of the static-equivalent pressure for high-explosive blasts. Author

N65-32406 Union Carbide Nuclear Co., Oak Ridge, Tenn. Y-12 Plant.
INTERPRETATION ON THE EXPECTED FATIGUE LIFE OF A THIRTY-INCH PRESSURE VESSEL WITH THREADED CLOSURE
H. A. Pohto and R. G. Sturm *In its* Compendium of Gas Autoclave Eng. Studies 23 Aug. 1965 p 201–215 refs (See N65-32400 21-15) CFSTI: $6.00

With the improvements in the state of the art of stress analysis by strain-gage techniques, it was decided to use strain gages for finding the stresses in the root of the internal threads of the bottom closure of this pressure vessel. This report deals with the analysis of these findings and interpreting the expected fatigue life of this isostat. Author

N65-32431* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
HIGH IMPACT TECHNOLOGY
J. L. Adams *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 94–96 (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

The accomplishments in the high impact testing program are summarized for transistors, crystal units, batteries, and gears. For the transistors tested all failures occurred at the bond between the lead wires and the semiconductor chip. Dummy crystal units impact-tested survived 10 000 g from 200 ft/sec both axially and radially with no detectable seal degradation. The crystal cases consisted of two ceramic discs joined by solder which was applied to treated chamfers on the edges of the discs. Various tests performed on battery cells are summarized. Also, a series of five tests was performed as part of an investigation of the behavior of gears under impact. In each test, two 96-tooth, 1/8-inch wide gears were meshed, one rigidly fixed to the testing fixture and the other eccentrically weighted so as to produce about 0.65 inch-ounce of torque in a 1 g field. The direction of impact was such that the torque would be about equal to the g-loading times the 0.65 inch-ounce value. E.E.B.

N65-32445*# Jet Propulsion Lab., Calif., Inst. of Tech., Pasadena.
VIBRATION TESTING OF A TAPE RECORDER DESIGNED FOR SPACECRAFT DATA STORAGE APPLICATIONS
W. G. Clement *In its* Space Programs Sum. No. 37-33, Vol. IV 30 Jun. 1965 p 182–187 (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

The unit tested was an isoelastic drive, reel-to-reel design. The recorder occupies a standard 6 by 6-inch module, weighs 2.5 lb, and is intended for hard mounting in the spacecraft; a 468-ft tape is driven at 15 inch/sec with less than 3 W input to the drive motor. Each of six different tests were performed initially and after each vibration stress imposed on the tape recorder. The tests are discussed. The recorder mechanism tested did not exhibit significant performance degradation as a result of the standard Mariner C type approval vibration stress levels. Although structural resonances existed for excitation frequencies between 40 and 2000 cps, 30-min dwells at these frequencies did not significantly degrade the mechanism. The merit of designing such mechanisms with low-mass bearing-supported elements is implicit. Minimum start voltage and start- and stop-time measurements were the most sensitive mechanical performance degradation criteria used in this test program and should be considered for use in future tests of this nature. E.E.B.

N65-32486 Brown Univ., Providence, R. I.
ON THE MACROSCOPIC THEORY OF INELASTIC STRESS-STRAIN-TIME-TEMPERATURE BEHAVIOR
D. C. Drucker *In* AGARD Advan. in Mater. Res. in the NATO Nations 1963 p 193–221 refs (See N65-32475 21-26) CFSTI: HC $8.35/MF $2.50

An attempt is made to delineate the scope and objectives of the macroscopic or phenomenological theory and to present a partial view of the present state of the subject and of the extensive critical areas of materials science whose exploration is just beginning. Emphasis is placed on the broad concepts underlying stress-strain relations and some attention is given to the problems of fatigue and brittle fracture. An effort is made to show the relation to, and perhaps more the contrast with, the approach of the physicist so that the enormous gap between the two can be brought more clearly into focus. Also, a brief discussion is given of irreversible thermodynamics and of the difficulties of its possible extension for use in the macroscopic theory. Added perspective on the role of materials science

is gained by exhibiting the great gap existing between most basic aspects of macroscopic theory and their eventual application in practice. Author

N65-32544 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL DETERMINATION OF DISTRIBUTION OF PRESSURE IN A THIN CIRCULAR PLATE COMPRESSED BETWEEN FLAT ANVILS
O. Ya. Shestopal and Ya. I. Shurin *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 309-315 refs (See N65-32506 21-25)

An installation was constructed for experimentally determining the distribution of pressure in a thin circular plate compressed between flat anvils. Through the surface of the lower anvil, grooves were drilled at different diameters, and manometers made from insulated wire were placed into the grooves. Experiments were conducted in which the anvils were compressed in intervals of equal pressure, with stops while the pressure was maintained, and the electrical resistance of the three manometers (central, middle, and external) was measured. The pressure corresponding to the readings of the manometer were calculated by formula. Different plate thicknesses were used in the experiments and the calculated pressure data are graphically shown. The data indicate that the readings of the external manometer were constantly maximum for a thin plate. Pressure in the center of the thin plate was lower than average pressure by a magnitude of 24% to 70% in various experiments. Pressure in the center of a thick plate showed a different character, and appeared to be higher than average by a magnitude of 20% to 35%. L.S.

N65-32546 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SPONTANEOUS DESTRUCTION DURING DEFORMATION OF SOLIDS
P. O. Pashkov *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 327-333 refs (See N65-32506 21-25)

Spontaneous destruction (cracking) occurring during the deformation of a solid material stretched by a tensile machine is discussed. Curves regarding tearing force, and possible forms of spontaneous destruction are presented and discussed. A configuration of an ideally brittle crack in the process of destruction is schematically depicted. The beginning of the crack is shown in heavy line print, and the position of the crack after advancement to an infinitesimal point is depicted by a dotted line. The magnitude of the shear, and the change in energy upon advancement of the crack at a constant speed is calculated in terms of the rate of crack formation. An expression for crack speed is derived. The theoretical results correspond to experimental data from the literature. L.S.

N65-32647*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ULTRASONIC TECHNIQUE FOR DETECTION AND MEASUREMENT OF FATIGUE CRACKS.
Stanley J. Klima, Daniel J. Lesco, and John C. Freche Washington, NASA, Sep. 1965 24 p refs
(NASA-TN-D-3007) CFSTI: HC $2.00/MF $0.50 CSCL 20K

An ultrasonic system was developed and used to observe the formation of fatigue cracks in center-notched sheet specimens of unalloyed aluminum, two aluminum alloys, a mild steel (approx. 0.035 percent carbon), and a nickel-base alloy. The reflection technique was used to detect minute fatigue cracks. The through-transmission technique was used to a limited extent to measure relatively long cracks. Actual lengths of detected cracks were determined by microscopic examination. Stress-life (S-N) curves of life to initial detectable cracks as well as S-N curves of life to fracture were obtained. In the sharply notched specimens utilized in this investigation, cracks were detected within approximately 1 to 3 percent of total specimen life for all the materials over the range of stresses considered. It was possible to detect smaller cracks with the reflection technique than with the through-transmission technique. The effects of crack orientation on instrument output with the reflection technique was studied by means of slots machined into flat plates. Slot surfaces normal to the direction of the ultrasonic waves produced the greatest voltage output. Author

N65-32649*# Dynatech Corp., Cambridge, Mass.
FLEXURAL VIBRATIONS OF THE PRESTRESSED TOROIDAL SHELL
Artis A. Liepins Washington, NASA, Sep. 1965 49 p refs (Contract NASw-955)
(NASA-CR-296) CFSTI: HC $3.00/MF $0.50 CSCL 20K

Results of a numerical study of the natural frequencies and modes of vibration of the pressure prestressed toroidal shell are presented. The analysis is based upon a linearized theory of vibrations of prestressed shells. The frequencies and mode shapes are obtained by trial and error in the Holzer fashion. The effects of wall bending stiffness on the frequencies of shells under varying degrees of prestress are shown. Author

N65-32683# Lockheed Missiles and Space Co., Sunnyvale, Calif.
THE DEFORMATION OF ORTHOTROPIC SHELLS OF REVOLUTION UNDER NONSYMMETRIC EDGE LOADS
W. Flügge (Stanford Univ.) and R. F. Hartung (Ph.D. Thesis—Stanford Univ.) Apr. 1965 140 p refs
(LMSC-TR-6-75-65-13)

The deformations which occur in a thin shell of revolution subjected to slowly varying, nonsymmetric edge loads are determined. The shell is assumed to be orthotropic with the axes of elastic symmetry coinciding with the lines of principal curvature of the shell middle surface. Furthermore, the meridian curves are considered to be smooth and parabolic of degree n at the apex, but otherwise arbitrary. The problem is reduced to the study of an eighth-order system of three simultaneous, ordinary differential equations with the meridional, circumferential, and normal displacements as dependent variables. Finally, by suitable transformations, uniformly valid solutions are obtained which reduce to both the previously determined shallow and non-shallow results in the appropriate region of the shell. Expressions for the stress resultants and stress couples are then given. Throughout the entire analysis, the important first harmonic (wind loading) is found to be an exceptional case and is treated as such in a separate section. Author

N65-32702# Illinois Univ., Urbana. Dept. of Civil Engineering.
INTERACTION OF PLANE ELASTIC WAVES WITH A THICK CYLINDRICAL SHELL Final Report, Dec. 1962-Mar. 1965
S. Paul, A. Robinson, and M. Ali-Akbarian Kirtland AFB, N. Mex., AF Weapons Lab., Jun. 1965 108 p refs
(Contract AF 29(601)-5007)
(AFWL-TR-65-31; AD-617405)

A method is presented for computing stresses in the vicinity of a lined cylindrical cavity in an infinite, elastic, isotropic, homogeneous medium as it is enveloped by a plane stress wave of dilatation traveling in a direction perpendicular to the axis of the cavity. Both the incident stress and the perturbations in the stress field are represented by Fourier series where the coefficients are functions of radius and time. A computer program was written to carry out the numerical computations. Hoop stresses in the liner and in

the medium at the liner-medium interface were computed at various angles around the opening for a plane longitudinal step wave. It was found that the maximum dynamic stresses occur on a diameter which is perpendicular to the direction of wave propagation, and that the dynamic stresses are sensitive to variation of the ratio of thickness of the liner to its radius, and stiffness of the liner relative to that of the medium. The maximum dynamic stresses were compared with the corresponding static values. In addition, the effect of decay and rise time of the incident on the maximum hoop stress was investigated. Author

N65-32706# David Taylor Model Basin, Washington, D. C.
SPHERICAL SHELL WEAKENED BY TWO UNEQUAL CIRCULAR HOLES
G. N. Savin, G. A. Van Fo Fy, and V. N. Buivol Mar. 1965 11 p refs Transl. into ENGLISH from Teoria Plastin i Obolochek, Tr. II, Vsesoiuzn Conf., Izd. Akad. Nauk (USSR), 1962 p 89
(DTMB-TRANS-320; AD-617534)

The method of successive approximations is used to obtain a solution of the problem of the distribution of stresses around two unequal circular holes in a spherical shell loaded by a constant internal pressure and constant shear forces along the contours of the holes. Finding the successive approximations is reduced to an equation solution under appropriate boundary conditions. Two approximations are found, a numerical example is discussed, and the boundaries of the applicability of the solution are indicated. Author

N65-32746# David Taylor Model Basin, Washington, D. C. Acoustics and Vibration Lab.
EXPERIMENTAL DETERMINATION OF STRUCTURAL AND STILL WATER DAMPING AND VIRTUAL MASS OF CONTROL SURFACES
Ralph C. Leibowitz and Arthur Kilcullen Apr. 1965 69 p refs
(DTMB-1836; AD-618751)

An experiment has been designed for determining the damping constants and virtual mass for the control surface systems of USS *Albacore* (AGSS 569) and USS *Sampson* (DDG 10); theoretical methods for determining the virtual inertias (including virtual mass) of these control surfaces are also given. The theoretical foundation for the experimental design and the procedure for analyzing the experimental data to obtain the parameters are described. These damping and inertial parameters are essential to the performance of a hull-control surface vibration and/or flutter analysis. Author

N65-32750*# General Motors Corp., Santa Barbara, Calif.
THIN SHEET IMPACT
C. J. Maiden, A. R. Mc Millan, and R. E. Sennett, III Washington, NASA, Sep. 1965 65 p refs
(Contract NAS9-3081)
(NASA-CR-295) CFSTI: HC $3.00/MF $0.75 CSCL 20K

Results are presented from a theoretical and experimental program to investigate the shielding necessary to protect a spacecraft from meteoroid impact damage. A previous study shows that heating effects from impact can melt or vaporize debris that passes through a thin shield. The momentum loading of this debris was measured and the results applied to calculating the response of the second sheet, using numerical shell analysis techniques. Shielding calculations and experiments predict that a first sheet of 0.20-mm aluminum and a second sheet of 1.40-mm 7075-T6 aluminum, 5.08 cm apart, will have a probability of 0.999 of no damage on an Apollo mission. Author

N65-32792# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ANALYSIS OF SPHERICAL SHELLS UNDER THE EFFECT OF CONCENTRATED FORCES
G. N. Chernyshev 22 Jul. 1963 11 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. (Moscow), no. 1, 1965 p 99–108

A segment of a thin elastic spherical shell of both constant and variable thickness is considered, where the shell material may be either isotropic or anisotropic. The stressed and strained states in the segment loaded by a concentrated effect (force or moment) applied at an arbitrary point are also formulated. A simpler problem of constructing the stressed state of a closed (edgeless) thin elastic spherical shell, caused by a concentrated force (or moment) applied at an arbitrary point and an equalizing concentrated effect at the upper pole of a geographic coordinate system, is considered and solved. W.M.R.

N65-32804# Purdue Univ., Lafayette, Ind. School of Aeronautics, Astronautics, and Engineering Sciences.
AN EXPERIMENTAL PROGRAM FOR FINITE LINEAR VISCOELASTICITY
Paul H. De Hoff, Jr. and George Lianis Jun. 1965 34 p refs
(Grant NSF GP-2677)
(A&ES-65-6)

An experimental program consisting of a series of isothermal uniaxial stress relaxation tests for various deformations ranging from approximately 10% to 210% strain is presented. For each relaxation test, the extension ratio λ was computed, and the specimen loads corresponding to certain prescribed instants of time were recorded. Of the two materials tested, it was found the Estane showed very little relaxation after five minutes; therefore, the stress was selected approximately as the equilibrium stress. The relaxation functions for Estane were evaluated from the isochronic curves. If the relaxation functions are assumed to be independent of the invariants, it can be shown that the five relaxation functions will be required to adequately describe the behavior of the Ethylene propylene. Additional tests are needed to describe the complete behavior of this material. R.W.H.

N65-32816# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ELASTIC-PLASTIC BENDING AND STABILITY OF A CIRCULAR CYLINDRICAL SHELL WITH INITIAL SHAPE IMPERFECTIONS
V. V. Sorokin [1965] 7 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. (Moscow); no. 3 1965 p 114–118

The stability beyond the elastic limit for shells with initial deviations from circular shape are considered. The presence of the deviations leads to the appearance of plastic deformation zones under loadings less than critical, and these are taken into account in the stability calculations performed. An analysis of the elastic-plastic deformation and carrying capacity of a shell was performed to illustrate the utilization of the dependences obtained from the calculations. The results of the computations are presented in the form of graphs. The curve of the equilibrium positions of the shell under a $q = 0.80q_*^\circ$ loading (q°_* is the critical pressure for a smooth shell); and a curve of the dependence of q_* on the amplitude of the intial deflection are presented. It was seen from the latter graph that the influence of the physical nonlinearity in the case under consideration leads to 15% to 20% reduction in the critical pressure even for insignificant initial deflections, as compared with the q°_* for a smooth shell. L.S.

N65-32823# Naval Civil Engineering Lab., Port Hueneme, Calif.
STATIC AND DYNAMIC BEHAVIOR OF FIXED-BASE PORTAL FRAMES
Stanley K. Takahashi and Richard H. Chiu Jun. 1965 149 p refs
(TR-R-337; AD-617718)

The objective of this report is to provide information on the static and dynamic design of steel portal frames. To provide comparisons between theoretical and experimental results, four steel portal frames, 8-feet high and 12-feet long, fabricated from 10B17 rolled sections, were tested under uniformly distributed static and dynamic loads. The loads were applied to one column of each frame to simulate a horizontal, traveling blast wave. The cross section of the loaded column was different from the cross section of the girder and the unloaded column. The frames were partially restrained at their bases. Maximum static and dynamic loads of 92,000 and 91,000 pounds, respectively, were applied over one column of each frame. The rise times of the dynamic loads were approximately 2 to 3 milliseconds, and the loads decayed exponentially to zero in about 1 second. An equivalent triangular load-time function was used for analysis. This report comprises results from twenty-three dynamic tests and one complete static test. The applied loads and the resulting deflections, strains, and accelerations were measured, and the reduced data are presented in graphical and tabular forms. Author

N65-32831# Sandia Corp., Livermore, Calif.
INTERPRETATION OF DYNAMIC DATA FOR SINUSOIDAL AND RANDOM VIBRATION TESTING
B. C. Ellis Jul. 1964 13 p
(Contract AT(29-1)-789)
(SCL-DC-64-83; Conf-701-9)

This paper describes the methods of using shock and vibration information required to specify and test for the dynamic environments a weapon system will experience. The gathering of data employs complete data acquisition and playback systems. Sandia interprets these data so that realistic design specifications can be made for the most efficient design of structural members and hardware. Author

N65-32866# TRG, Inc., Melville, N.Y.
EXPERIMENTAL STUDY OF MECHANICAL RESONATORS ATTACHED TO BARS
David Yarmush and S. Aronson May 1964 39 p refs
(Contract Nonr-3208(00))
(TRG-142-TN-64-11; AD-617341)

Mechanical elements, resonant at chosen frequencies, were attached at their nodal point to prismatic bars. The response of the bars to various vibrational inputs were studied. It was found that these elements tend to suppress the response of the bars in the vicinity of the resonant frequency. When several elements were placed on the bar, the total effect in specific geometries was stronger than the sum of the individual effects, and the frequency stop-band was broadened. Author

N65-32875*# National Aeronautics and Space Administration Washington, D. C.
AIRCRAFT STRUCTURAL TESTS [ESSAIS DE STRUCTURES AVIONS]
Sep. 1965 71 p Transl. into ENGLISH from a Rept. of the Etablissement Aeron. de Toulouse (France), 7 May 1965
(NASA-TT-F-9508) CFSTI: HC $3.00/MF $0.75 CSCL 01C

Technical specifications to furnish equipment and supplies for static and thermal structural aircraft tests are presented on the supersonic Mach-2 Concord, including analog and digital computer elements for in-test data reduction, power supply systems based on thyristors, kinetic heating simulators, control equipment, etc. Charts and diagrams of the overall project and floor plans of the construction hangars and testing rooms are included. Author

N65-32881*# Texas A&M Univ., College Station.
FOUNDATIONS OF LINEAR INELASTIC SHELL THEORY Progress Report
T. J. Kozik Aug. 1965 156 p
(Grant NsG-239-62)
(NASA-CR-64708) CFSTI: HC $5.00/MF $1.00 CSCL 20K

An introduction to the assumptions and limitations of linear shell analysis is presented as based on the Kirchoff hypotheses and using a vector approach. Since principal curvilinear coordinates are used exclusively, the resulting equations developed by vector methods are not particularly complex and many of the important concepts presented are easily grasped. Emphasis is placed on differential geometry. Much confusion with regard to strains, curvature changes, twist, and compatibility is eliminated by considering a surface and its deformation. By first developing the general equations for a surface, a means for deriving the corresponding nonlinear expressions is made available. A great deal of the analysis depends on the orthonormal triad of vectors of the undeformed surface and their derivatives. The derivatives of these vectors are given in the addendum. R.N.A.

N65-32893 General Motors Corp., Indianapolis, Ind. Allison Div.
RANDOM MOTION VIBRATION ANALYSIS
J. E. Westwick and E. W. Sickmeier *In its* Allison Res. and Eng. Rept., Vol. 7, 3d Quarter 1965 p 2-14 refs (See N65-32892 21-34)

Recent activity in state-of-the-art methods of random motion analysis is reviewed. The mean-square or square-law detector, log converter analog, and autocorrelation function digital methods are discussed. Approximate mathematical expressions which describe each of these techniques are given. Power spectral density plots showing analog and digital processing of a controlled random environment, and strain gage response to random excitation showing structural fatigue in the process are among the graphs included. C.T.C.

N65-32937# Aerospace Corp., El Segundo, Calif.
AEROSPACE METEOROID ENVIRONMENT AND PENETRATION CRITERION
V. C. Frost 17 Aug. 1964 48 p refs
(Contract AF 04(695)-269)
(TOR-269(4560-40)-2; AD-465431)

A simple and definite procedure was established for the design of certain types of space vehicle structure to resist meteoroid penetration. This procedure is recommended as an interim measure for the purpose of unifying the design methods currently in use. The possible variations in the individual environmental and penetration parameters were identified and their effect on the degree of overall system uncertainty was established in a qualitative manner. The possible use and method of application of a system safety factor was examined. R.N.A.

N65-33010# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LONGITUDINAL SHOCK ALONG A CYLINDRICAL SHELL

L. A. Movsisyan 13 Jul. 1965 9 p refs Transl. into ENGLISH from Izv. Akad. Nauk Arm. SSR, Ser. Fiz.-Mat. Nauk (USSR), v. 17, no. 5, 1964 p 43–46
(FTD-TT-65-362/1+4; AD-618014)

The behavior of a circular orthotopic cylindrical shell exposed to the longitudinal impact of a rigid mass is investigated in a framework of momentless theory. R.N.A.

N65-33049# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Mülheim an der Ruhr (West Germany).
ON THE BUCKLING OF CYLINDRICAL SHELLS BY THE AXIAL IMPACT [UBER DAS BEULVERHALTEN VON KREISZYLINDERSCHALEN BEI SCHLAGARTIGER AXIALBELASTUNG]
H. Schwieger and Chr. Spuida May 1965 40 p refs In GERMAN, ENGLISH summary
(DLR-FB-65-23; DVL-422) CFSTI: HC $2.00/MF $0.50

The buckling phenomenon caused by axial impact of a ring-shaped mass on a circular cylindrical shell was investigated experimentally. The cylindrical shell consisted of duralumin, and the ratio of shell radius to shell thickness was 500. The different intervals for elastic axial impact, elastic buckling impact, and elastic-plastic buckling impact were established by varying the energy of the impact mass. The buckling phenomenon was studied by means of high-speed photography. The results of all tests show diamond-shaped buckles near the impacted boundary of the shell. The contact time and the displacement of the impact mass were also measured. Author

N65-33141*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SUMMARY OF THE FUNCTIONS AND CAPABILITIES OF THE STRUCTURAL ANALYSIS SYSTEM COMPUTER PROGRAM
Theodore E. Lang 15 Jun. 1965 27 p refs
(Contract NAS7-100)
(NASA-CR-64622; JPL-TR-33-220) CFSTI: HC $2.00/MF $0.50 CSCL 20K

The functions and operations of a large capacity Structural Analysis System Computer Program developed to analyze frame and shell-type structures are described. Included is a summary of the capabilities of the program and a discussion of certain of the problems encountered in development of the program. The participation of engineering personnel in the setup and running of a typical shell problem is outlined. Author

N65-33191*# State Univ. of Iowa, Iowa City.
ON MAPPING FUNCTIONS FOR TORSIONAL ANALYSIS OF SPLINED SHAFTS
Kwan Rim and Louis Camillo (Deere and Co., Moline, Ill.) [1965] 22 p refs Submitted for Publication
(Grant NsG-576)
(NASA-CR-64782) CFSTI: HC $1.00/MF $0.50 CSCL 20K

The purpose of this paper is to introduce a practical method of deriving relatively simple mapping functions, which are needed in the torsional analysis of splined shafts. The form of the mapping functions being simple, it is shown that the analytical solutions are readily obtainable without undue labor, and that an approximate but systematic analysis of any splined shaft is now possible. The mapping functions are also capable of analyzing splined shafts with very sharp re-entrant corners, which would not only defy the known methods of numerical analysis but also present some difficulties to experimental methods of analysis. Torsional analysis of a typical splined shaft is carried out; and the experimental errors associated with sharp re-entrant corners are illustrated through a carefully conducted experiment. Author

N65-33225# Forest Products Lab., Madison, Wis.
BUCKLING COEFFICIENTS FOR SIMPLY SUPPORTED AND CLAMPED FLAT, RECTANGULAR SANDWICH PANELS UNDER EDGEWISE COMPRESSION
Edward W. Kuenzi, Charles B. Norris, and Paul M. Jenkinson Dec. 1964 137 p refs
(Contract AF 33(657)-63-358; BuWEPS Order 19-64-8041-WEPS)
(FPL-070; AD-610683)

This report presents curves of coefficients and formulas for use in calculating the buckling of flat panels of sandwich construction under edgewise compressive loads. The curves were derived for sandwich panels having one facing of either of two orthotropic materials, the other facing of an isotropic material; both facings of orthotropic material; both facings of isotropic material; and cores of orthotropic or isotropic material. Parameters are chosen so that facings may be of different thicknesses and so that isotropic facings can also be of different isotropic materials. Curves were derived for various edge conditions, simply supported and clamped. Author

N65-33341# Allied Research Associates, Inc., Concord, Mass.
OPTIMUM STRUCTURAL DESIGN CONCEPTS FOR AEROSPACE VEHICLES: BIBLIOGRAPHY AND ASSESSMENT
George Gerard Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Jun. 1965 71 p refs
(Contract AF 33(615)-1840)
(ARA-TR-272-2; AFFDL-TR-65-9; AD-468335)

Minimum weight design of aerospace structures has evolved during the past two decades into a rather rigorous scientific discipline that permits the rational selection of structural configurations and materials for various design requirements. Because of the pertinence of this body of literature to the structural design of advanced aerospace vehicles, a comprehensive bibliography of published literature on optimum structural design has been compiled and reviewed herein. In Part 1, a critical historical review highlights the significant advances in the literature concerned with analytical optimum design techniques for various structural elements, materials and thermal protection systems. The annotated bibliography is contained in Part 2. In Part 3, the current state of the art of the theory of optimum structural and thermostructural design is assessed. Included are the derivation of design indices resulting from various design requirements, a generalized presentation of optimum design theory and preferred methods of presenting optimum design results. Author

N65-33354*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ON FREE VIBRATIONS OF ECCENTRICALLY STIFFENED CYLINDRICAL SHELLS AND FLAT PLATES
Martin M. Mikulas, Jr. and John A. Mc Elman Washington, NASA, Sep. 1965 25 p refs
(NASA-TN-D-3010) CFSTI: HC $1.00/MF $0.50 CSCL 20K

Dynamic equilibrium equations and boundary conditions are derived from energy principles for eccentrically stiffened cylinders and flat plates. Inplane inertias are neglected and frequency expressions are obtained for simple-support boundary conditions for both the cylinder and the plate. Results in the form of plots of frequencies as a function of mode shape illustrate the effects of eccentricities. It is found that these eccentricities can have a significant effect on natural frequencies and should be investigated in any dynamic analysis of stiffened structural members. Author

N65-33378# Massachusetts Inst. of Tech., Cambridge.
PLASTIC DEFORMATION IN RANDOM VIBRATION

Dean Karnopp and Terry D. Scharton Jun. 1965 33 p refs (Contract AF 49(638)-1314)
(AFOSR-65-0987; AD-619876)

A randomly excited single degree of freedom oscillator in which an idealized form of plastic deformation can take place is studied. Through the use of an artificial process, statistics of this nonlinear, hysteretic system are reduced from linear system response statistics in two regimes of operation. The expected accumulated plastic deformation is found as a function of time and some other statistics derivable from the artificial process are indicated. Applications of these methods and results to the prediction of fatigue life under random vibration are discussed. Author

N65-33386# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STABILITY OF AN ANISOTROPIC CIRCULAR CYLINDRICAL SHELL DURING LONGITUDINAL COMPRESSION, INTERNAL PRESSURE AND IRREGULAR HEATING IN LENGTH
V. V. Kabanov 11 May 1965 13 p refs Transl. into ENGLISH from Tepl. Napryazh. Elementakh Konstrukt., Dokl. Nauch. Soveshch., Akad. Nauk Ukr. SSR, Inst. Mekh. (USSR), no. 4, 1964 p 159–167
(FTD-TT-65-444/1+2; AD-615872)

Linear stability of an anisotropic circular cylindrical duralumin shell of average length is discussed. An equation of stability is evolved, and the values of rigidity coefficients of a shell with identical grids of longitudinal and transverse reinforcements are listed. It is shown that the critical value of force amplitude depends substantially on the degree of its heterogeneity. The center part of the shell is examined, and stresses are determined by solving an axially symmetrical problem. Boundary conditions are the (1) conjugations of heated and unheated parts of the shell and (2) extinguishing thermal stresses of length. Circumferential forces in the shell are expressed by a formula, and the stability problem is solved by another equation. For short shells, in which thermal stresses bear a local character, another expression is given. The critical temperature is obtained, and this expression indicates that loss in stability is possible only at a very small h/R value.
M.W.R.

N65-33393# Pennsylvania State Univ., University Park. Dept. of Engineering Mechanics.
A TRIAXIAL EXPERIMENT ON YIELD CONDITION IN PLASTICITY
L.W. Hu, J. Markowitz, and T. A. Bartush Jan. 1965 22 p refs (Grant AF-AFOSR-127-64)
(AFOSR-65-0313; AD-614574)

A triaxial stress experiment was developed for the determination of the intersections of the initial and subsequent yield surfaces with a hydrostatic stress-principal stress plane. Results of an experiment on Nittany Brass No. 2 of the soft grade were reported. Information so obtained makes it possible for one to see the yield condition in the sense of a three dimensional surface rather than a two dimensional curve as observed in conventional biaxial stress tests. Author

N65-33403# Martin Co., Baltimore, Md.
HYDROFOIL SHIP STRUCTURAL DESIGN CRITERIA STUDY Final Report
Feb. 1965 235 p refs Supersedes ER-11706
(Contract NObs-4791)
(ER-13727; ER-11706; AD-469181)

A study was made of environmental conditions and vehicle response characteristics to develop a method for determining design criteria for hydrofoil ships. Loading conditions are analyzed for hullborne and foilborne conditions to determine statistical distributions of the pressures and loads expected on various hull areas. These loadings are compared with existing seaplane loading specifications and interpreted in terms of past experience in seaplane design. A structural analysis for overall hull bending, bottom plating and stringers, and decks and supporting structures is conducted for static strength, fatigue life, and stiffness under the loading conditions. Statistical loadings for struts and foils are determined. The structural analysis showed that static strength and fatigue life must be considered in the hydrofoil design. Fatigue life is the determining factor for overall hull bending and local design of forward areas of the hull bottom, while static strength or stiffness is most important on midship and after areas of the hull and deck structure. Low deadrise angles lead to large local pressures and high landing accelerations which may become critical for static strength determination of overall hull bending.
R.N.A.

N65-33424# Army Missile Command, Huntsville, Ala. Stress and Thermodynamics Branch.
BUCKLING OF SPHERICAL SHELLS
Grady E. Patrick, Jr. 9 Jun. 1965 11 p refs
(RS-TR-65-5; AD-468610)

A closed solution has been developed to calculate the critical buckling load of a uniformly loaded sphere which may be applied to a spherical segment with a varying load (provided axisymmetric and radial) and a varying thickness. The results for a uniformly loaded sphere are approximately those obtained from the classical solution; but the ability to include varying thicknesses gives an advantage over the classical solution.
Author

N65-33428# Watervliet Arsenal, N. Y. Benét Labs.
PHOTOELASTIC STRESS ANALYSIS OF THICK-WALLED CLOSED-END CYLINDERS
Thomas F. Maclaughlin Mar. 1965 25 p refs
(WVT-6514; AD-463006)

A three-dimensional photoelastic stress analysis was conducted on six thick-walled closed-end cylinders subjected to internal pressure loading. The cylinders were approximately similar in design to the breech chamber of a large caliber tank weapon. Maximum octahedral shear stresses were determined in the side wall-end wall juncture of essentially flat-ended cylinders (similar to the actual weapon component) and in hemispherically-ended cylinders. The purpose of the study was to learn more about the stresses in the closed end of the cylinder so that future components of this type may be designed more efficiently with regard to stress and weight. Author

N65-33461# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
THE BUCKLING BEHAVIOR OF UNIFORMLY HEATED THIN CIRCULAR CYLINDRICAL SHELLS
Bernard Ross, Nicholas J. Hoff, and Wilfred H. Horton Apr. 1965 67 p refs
(Contract AF 49(638)-1276)
(SUDAER-225; AFOSR-65-0982; AD-619092)

The results of buckling tests on uniformly heated, clamped, thin circular cylindrical shells are presented and discussed. Particular attention is paid to both the actual buckling process and the ensuing postbuckling behavior. Load versus end shortening curves are included and it is remarked that, in the thermal buckling problem, such curves are nonlinear. The possibility of

"snap-through" buckling which occurs at a value of end shortening greater than that corresponding to the maximum supported load, is experimentally verified. a comparison of the present load is experimentally verified. A comparison of the present experimental results with available theory is made. It is observed that the experiment values of the buckling temperature can be substantially greater than the temperatures calculated by linear theory from the experimental buckling loads. Author

N65-33465# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
PROGRAMS FOR MACHINE COMPUTATION OF ROTOR BLADE DOWNWASH
Nancy Ghareeb Aug. 1964 89 p ref
(Contract NOw-62-0100-d)
(TR-107-1; AD-619285)

Programs, written in Fortran II, are presented for computing the downwash due to trailing wake and shed wake; and a straight line approximation to wake; and for analyzing the rotor load. Typical results from each program are also included. M.G.J.

N65-33472# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
BUCKLING OF CIRCULAR CYLINDRICAL SHELLS UNDER EXTERNAL PRESSURE
Tsai-Chen Soong Apr. 1965 41 p refs
(Contract AF 49(638)-1276)
(SUDAER-228; AFOSR-65-0986; AD-619684)

A set of uncoupled differential equations of equilibrium based on Sanders' assumptions has been developed which includes the effects of the prestresses. Both the Sanders-type equations and Donnell's equations are solved for the buckling pressure of shells under lateral and hydrostatic pressure. It is found that restriction of the axial displacement has considerable influence upon the buckling pressure. Moreover, the more rigorous Sanders-type equations yield lower buckling pressures than Donnell's equations. Author

N65-33503*# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics.
A METHOD FOR DETERMINING AN OPTIMUM SHAPE OF A CLASS OF THIN SHELLS OF REVOLUTION
Morris Stern, Han-chung Wang, and Will J. Worley Jul. 1965 52 p refs
(Grant NGR-14-005-010)
(NASA-CR-64840; T&AM-281) CFSTI: HC $3.00/MF $0.50 CSCL 13M

This third report under the current grant is concerned with a method for determining an optimum shape of a convex shell of revolution with respect to volume, weight and length. The technique used depends on replacing the class of functions, over which the shape may range, by the parameters b/a, α and β in the equation

$$\left|\frac{x}{a}\right|^{\alpha} + \left|\frac{y}{b}\right|^{\beta} = 1$$

where a, b, α and β are positive constants not necessarily integers, with α and β equal to or greater than unity. The bodies of revolution are generated by revolving the line, described by the above equation, about the x-axis. The procedure is illustrated for a thin shell which will fit within the space defined by a circular cylinder of radius b and length 2a. The shell is optimized, in terms of α and β, with respect to volume and weight. The FORTRAN program used to achieve these results is presented in Appendix B. Author

N65-33521# Brown Univ., Providence, R. I. Div. of Engineering.
THE DYNAMIC STRESS–STRAIN RELATION OF METALS AS DETERMINED FROM IMPACT TESTS WITH A HARD BALL
C. H. Mok and J. Duffy Jun. 1964 58 p refs
(Contract Nonr-562(20))
(AD-603929)

An analysis is presented of the impact process occurring when a hard ball strikes the surface of a large metal specimen. It is shown that the results of dynamic indentation tests can be interpreted to provide a measure of the yield stress of the metal over a range of strains taking into account the influence of strain-rate. Experiments are described in which steel balls are allowed to drop onto specimens of lead, steel and aluminum. In each test the velocities of impact and rebound are measured as well as the diameter of the indentation remaining in the metal specimen and the time of contact between specimen and indenter. These experimental results are used in conjunction with the analysis to provide for each metal a dynamic stress–strain curve which is then compared to results of a simple compression test performed under impact conditions. For all metals the best agreement occurs if the simple compression tests are performed at a strain-rate of 1,500 sec^{-1}. Finally, the present analysis provides a model of the indentation process which furnishes quite accurate predictions of the size of the permanent indentation, the time of contact during impact and the coefficient of restitution, if the dynamic stress–strain relation of the material is known. Author

N65-33541*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
BALLOON TANK SKIN STRAIN MEASUREMENTS AT LIQUID-HYDROGEN TEMPERATURE ON CENTAUR FLIGHT VEHICLE
Tilak R. Lall, Frank A. Maruna, and William F. Lang, Jr. Washington, NASA, Sep. 1965 21 p refs
(NASA-TM-X-1147) CFSTI: HC $1.00/MF $0.50 CSCL 20K

The Centaur liquid-hydrogen tank at station 402 was instrumented with four strain-gage installations on the Atlas-Centaur AC-3 flight vehicle. These gages were subjected to an extremely severe environment both during vehicle assembly at Cape Kennedy and during flight when the temperature at the gage was −423° F. This report covers the installation of the gages, the signal-conditioning equipment and system calibration, and analysis and evaluation of data obtained from the flight. In spite of the severe environment both before and during the flight, useful data were obtained to evaluate structural performance. Incremental loads from launch to booster engine cutoff obtained from the strain gages were compared with the values computed from known mass distribution and gravity environment. Of the values at the four gage locations, two agreed almost exactly with calculated values. Of the other two, one differed by 12 percent and the other by 15 percent. Although bonded gages have been in use in the laboratory at liquid-hydrogen temperatures, this technique on flight vehicles presented many problems. The results indicate, however, though the bonding process is a painstaking one, such gages can be a valuable tool for evaluating flight structural performance. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N65-32407 Union Carbide Nuclear Co., Oak Ridge, Tenn. Y-12 Plant.

HEAT LOSS EVALUATION FOR Y-12 DEVELOPMENT FURNACE

W. R. Gambill *In its* Compendium of Gas Autoclave Eng. Studies 23 Aug. 1965 p 217–237 refs (See N65-32400 21-15) CFSTI: $6.00

The effectiveness of a furnace insulation system, designed for a Pressure Vessel, has been determined. Numerical results were obtained for heater and heat-sink temperatures of 3000 and 40° F, respectively. It appears that the top and bottom coils providing 10 kw each and a cylindrical coil rated at 100 kw (all at a 3000° F operating temperature) would be more than adequate for steady-state operation. Author

N65-32432* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

HEATING-COOLING TIME FOR A PLANETARY LANDER SURVIVAL PAYLOAD

J. Hultberg *In its* Space Programs Sum. No. 37–33, Vol. IV 30 Jun. 1965 p 97–98 ref (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

A method for the calculation of the transient heating and cooling time associated with a survival payload with a low thermal resistance in comparison to the thermal resistance of the surrounding energy absorber is described. Also, a numerical example is given for illustration. The time-temperature history for the heating of a lander survival payload from an ambient temperature at 15° to 130° C with an outside surface temperature at 135° C is calculated for a package covered with balsa wood 15-inch thick with a thermal conductivity of 0.0225 Btu/hr ft °F, density of 7 lb/ft^3, and specific heat of 0.327 Btu/lb °F. The survival payload had a diameter of 15 inches, an average density of 50 lb/ft^3, and an average specific heat of 0.25 Btu/lb °F. The geometry and properties described gave a value for the ratio of conductance to heat capacity of 0.206 if the heat capacity of the insulation is neglected and a value of 0.0036 if the entire capacity of the energy absorber is combined with the heat capacity of the survival payload. E.E.B.

N65-32433* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

ANALYSIS OF EQUILIBRIUM SHOCK-LAYER RADIATION FOR ATMOSPHERIC ENTRY TO MARS

F. Wolf and J. Spiegel *In its* Space Programs Sum. No. 37–33, Vol. IV 30 Jun. 1965 p 99–103 refs (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

The gas radiance of mixtures simulating the Martian atmosphere was calculated. The total equilibrium radiation intensity of a 30% carbon dioxide and 70% nitrogen mixture behind the normal shock is given as a function of the free-stream density with flight velocity as a parameter. The total equilibrium radiative energy to the stagnation region was also determined for the same mixture. From the study it appears necessary to compute equilibrium radiation at much lower density than where experimental data exist. The simple procedure of normalizing to free-stream density appears to introduce some problems. At a fixed velocity, density dependence of radiation is acceptable for engineering estimates. The density dependence with velocity is significant. For more exact heat transfer predictions, a simple exponential density dependence should not be used. E.E.B.

N65-32436* Jet Propulsion Lab., Calif., Inst. of Tech., Pasadena.

ARC-IMAGING FURNACE IGNITION TEST FACILITY

L. Strand *In its* Space Programs Sum. No. 37–33, Vol. IV 30 Jun. 1965 p 117–125 ref (See N65-32410 21-11) CFSTI: HC $7.00/MF $1.75

The arc-imaging furnace combines a high-intensity radiation source with an optical system for reimaging the radiant energy onto a propellant sample. The radiation source is a 10 to 20 kW carbon arc struck between two 10-mm carbon rods. The tail flame plasma is concentrated by a ring of impinging air jets located on the anode holder. The concentration of the tail flame allows the arc to be focused at the reimaging source. A magnetic field surrounding the anode stabilizes the arc by rotating the plasma stream. The ignition test equipment, control system, calorimeter calibration, test procedures, and results are given. E.E.B.

N65-32515 Air Force Systems Command, Wright-Patterson AFT, Ohio. Foreign Technology Div.

ONE-DIMENSIONAL INSTABILITY AND ATTENUATION OF DETONATION

R. M. Zaydel' and Ya. B. Zeldovich *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 85–96 refs (See N65-32506 21-25)

Calculations are worked out for solving the stability of a detonation wave with respect to the distance between the shock wave and the zone of chemical reaction. Where the front of the wave (just as the surface on which the reaction is taking place) remains plane, and the direction of speed on which the reaction is taking place remains changed, the disturbance is called one-dimensional. In addition to the calculations, qualitative considerations in favor of the assumption on the possibility of one-dimensional instability during sufficiently great heat of activation for the reaction, are presented. L.S.

N65-32516 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE STABILITY OF THE CHAPMAN-JOUGUET DETONATION

V. V. Pukhnachev *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 97–109 refs (See N65-32506 21-25)

A mathematical model of detonation is considered in an attempt to find out why the simplest solution of hydrodynamics and chemical kinetics equations are not realized in many observed cases of propagation plane stationary detonation waves; and to find out why the complicated phenomenon of spin detonation occurs. L.S.

N65-32517 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE IGNITION OF POWDERS AND EXPLOSIVES

V. B. Librovich *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 110–119 refs (See N65-32506 21-25)

Ignition problems are formulated and calculations are worked out. Ignition of powders and explosives by hot gas flow is considered for the case when the gasification of a condensed substance occurs wholly due to the supply of heat to the surface of gasification, from the flame of gasiform decomposition products from the substance being burned. Ignition of a powder both with weak heat supply, and strong heat supply; and the transition from igntion to conditions of stationary burning are discussed, along with the calculations. L.S.

N65-32518 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

BURNING OF DROPS OF FUEL IN A FLOW OF HEATED AIR

L. A. Klyachko and A. V. Kudryavchev *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 120–131 refs (See N65-32506 21-25)

The theory of burning fuel drops moving relative to a gaseous oxidizer (in forced convection) is developed, taking into account the dependence of physical constants (coefficients of thermal conduction and diffusion, and heat capacity of fuel vapor) on temperature. Experimental results are given for the burning of kerosene, isooctane, and ethyl alcohol fuel drops suspended on a filament in a flow of highly-heated air, and agree with theory. A diagram of the experimental apparatus is shown. Curves showing the change of drop current diameter with time, and curves showing the dependence of the vaporization constant on the air flow speed are presented. The experimental data are tabulated, and designation of symbols used in the calculations are given. L.S.

N65-32525 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THROWING OF A BALL BY A FLAT LAYER OF EXPLOSIVE

Yu. I. Fadeyenko *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 179–182 refs (See N65-32506 21-25)

The problem of the motion of a ball accelerated by detonation products from a flat layer of explosive is considered. A diagram of the initial configuration is depicted. The expression for the scattering of detonation products is given, and a force formula for the flow of gases acting on a ball, along with a constant obtained from experimental data from the literature, are utilized in the computations. Supersonic flow conditions are assumed. Also introduced into the calculations are coordinate and ball velocity designations. A final mathematical expression for solving the ball motion problem is shown. L.S.

N65-32526 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EFFECTIVE TEMPERATURE OF BURNING OF CERTAIN EXPLOSIVE SUBSTANCES

A. F. Velyayev and G. V. Lukashenya *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 183–194 refs (See N65-32506 21-25)

Experiments were conducted in which explosive substances (nitroglycol, nitroglycerine, methylnitrate, tetryl, hexogene, and trotyl were heated in an electric furnace (which was enclosed in a pressure chamber) for the purpose of determining the effective temperature T_3 (the temperature of the leading stage of an explosion) for establishing the character of the ensuing explosion. Pressure, temperature, and burning rate data are tabulated. Results indicate that the magnitude of the temperature coefficient of the burning rate β dln u/dT_0 can satisfactorily determine T_3. Studies were also conducted for determining the temperature coefficient of burning rate for ammonium perchlorate. The data are also depicted in various graphs, and calculations for obtaining theoretical values are given. L.S.

N65-32527 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

REMARKS ABOUT THE INFLUENCE OF CONDENSED REMAINDER ON DEPENDENCY OF BURNING RATE ON PRESSURE

N. N. Bakhman *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 195–198 refs (See N65-32506 21-25)

Calculations are performed with experimental data on the burning of condensed systems for which the burning rate u drops with the growth of p over a definite pressure interval p. It is shown that for systems burning in the gaseous phase, the presence of a dense layer of condensed residual substance can serve as the cause for u dropping with increasing p. Thus by introducing additives into the system, which prevent the formation of a cohering layer, it is possible to change the form of the u(p) curve. L.S.

N65-32530 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MEASUREMENT OF VELOCITY OF PROPAGATION OF FLAME BY METHOD OF BOMB OF CONSTANT VOLUME

V. S. Babkin, L. S. Kozachenko, and I. L. Kuznetsov *In its* J. of Appl. Mech and Tech. Phys., No. 6 9 Apr. 1965 p 212–218 refs (See N65-32506 21-25)

An analysis of experimental data on flame propagation velocity, obtained by a constant volume bomb method, is presented. Local coefficients of expansion E_u are considered. On the basis of the fact that in the initial moment of propagation of a flame E_u should be equal to the expansion coefficient of combustion products E, during the burning at constant pressure, three mixtures corresponding to literature data were compared among themselves and with real expansion coefficients. Results of the calculations are tabulated. The comparisons show that all coefficients of expansion differ from each other and from the real coefficient of expansion for a given mixture. L.S.

N65-32531 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INITIATION OF DETONATION OF SHOCK WAVE IN POURED TROTYL

A. N. Dremin, S. A. Koldunov, and K. K. Shvedov *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 219–225 refs (See N65-32506 21-25)

Experimental data are presented on shock waves with flat fronts, initiated by detonating charges of poured trotyl explosive (TNT), density ρ_0= 1.62. Pressure on the wave front was 100 000 atm. Two parameters, D (the velocity of the shock wave) and u (the velocity of substance behind the shock front) were measured in the region covering the region of shock wave entry up to the establishment of normal detonation. The measurements were used for calculating the pressure p and the density behind the shock front, and the data are tabulated. On the basis of obtained data, it is indicated that the chemical reaction on the boundary appears almost instantly even for imperfect conditions. The data obtained and the resulting considerations do not correspond to existing ideas about the mechanism of initiation of shock waves in condensed trotyl. L.S.

N65-32541 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CRITICAL PHENOMENA IN PROCESSES OF BUBBLING AND BOILING

I. G. Malenkov *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 292–298 refs (See N65-32506 21-25)

Experiments simulating the bubbling process of boiling in a large volume during free convection were conducted for the purpose of establishing both a qualitative and quantitative conformity between the hydrodynamics during boiling and bubbling. The moment at which the structural changes in the two-phase boundary layer begins, was determined by three different methods which are described. Photographs of bubble transition were taken, and graphs are presented showing the structural crises of the two-phase layer during bubbling and boiling. The critical velocity of bubbling, k, was calculated for distilled water, ethyl alcohol, and benzene systems, and the values coincide closely with the experimental values. L.S.

N65-32542 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TEMPERATURE STATE OF A THIN SPHERICAL SHELL
V. S. Zarubin *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 299–304 refs (See N65-32506 21-25)

A graphic diagram was derived for use in determining the steady temperature state of a thin opaque spherical shell (e.g. an artificial earth satellite). The medium in the cavity of the shell is assumed to be diathermic, and radiation of the internal surface is gray and diffused. Temperature with respect to thickness of the shell is considered constant, and transmission of heat by thermal conduction along the shell is disregarded. The peculiarity of the sphere's geometry is that the effective and incident specific radiant heat flow under the assumptions made, does not depend on the coordinates and constant for any point of the internal surface. An expression is derived for the temperature distribution of a motionless sphere under the action of only solar radiation, and an expression is derived for the heat flow balance for a rotating shell. In the latter case, the influence of rotation with constant angular velocity relative to an arbitrary axis passing through the center of the sphere is considered. A quasi-stationary solution for the temperature state of the surface of a shell that has revolved for a considerable period of time, is also presented. L.S.

N65-32543 Air Force Systems Command, Wright-Patterson, AFB, Ohio. Foreign Technology Div.
HEATING OF A TWO-LAYER PLATE
M. D. Mikhaylov *In its* J. of Appl. Mech. and Tech. Phys., No. 6 9 Apr. 1965 p 305–308 refs (See N65-32506 21-25)

Dimensionless coordinates and numbers are introduced into a thermal conduction equation for specified boundary conditions, and an expression is derived for the distribution of temperature in the surface of a two-layer plate having thermal insulation. The solution is applicable to the problem of calculating the heat distribution in the surface of a wing having thermal insulation. L.S.

N65-32584 Joint Publications Research Service, Washington, D. C.
IDEAL PHYSICAL CHANNEL OF INFORMATION TRANSMISSION
L. B. Levitin *In its* Probl. in Inform. Transmission 16 Aug. 1965 p 89–93 refs (See N65-32575 21-08) CFSTI: $3.00

The entropy defect principle was used to calculate the properties of an ideal physical information transmission channel, in which the transmitter gives the microstate of the signal sent, the receiver determines the microstate of the received signal, and where additive independent noise is present. It was proven, that the distribution of the microstates of the noise corresponds to the thermodynamic equilibrium of the investigated system. Information transmitted along several independent channels of the investigated type will be most efficient if the systems come to a state of thermal equilibrium with each other and reach identical temperatures. G.G.

N65-32609# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HEAT POWER ENGINEERING Selected Articles
8 Jun. 1965 41 p refs Transl. into ENGLISH from Teploenerg. (Moscow), v. 10, no. 11, 1963 p 2–12, 81–85
(FTD-MT-64-461; AD-618313)

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N65-32610 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOME PROBLEMS IN THE DESIGNING OF SUPERPOWERFUL SINGLE-PASS BOILERS
V. M. Biman *In its* Heat Power Eng. 8 Jun. 1965 p 1–27 (See N65-32609 21-33)

The development in the U.S.S.R. of powerful thermal electric power stations having 300, 500 and 800 MW blocks is discussed. The design proposed for a superpowerful boiler is intended to remain simple and economical, requiring no scarce and expensive materials. Unification and normalization of manufacture at a given factory is suggested to facilitate multiple recurrence of components and units. W.M.R.

N65-32611 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMODYNAMIC PROPERTIES OF AIR TO 1000°C AND 1000 BAR
A. A. Vasserman *In its* Heat Power Eng. 8 Jun. 1965 p 28–38 refs (See N65-32609 21-33)

The values of thermodynamic properties of air in the interval of temperatures from 0 to 1000° C and pressures from 1 to 1000 bar, calculated according to the equation of state [10] are presented, and they are compared with available experimental and calculating data. Author

N65-32673*# Rocketdyne, Canoga Park, Calif.
STATISTICAL ANALYSIS FOR THERMOMETRIC SENSORS TEST PROGRAM Final Report
S. R. Webb, H. Kaspar, and J. M. Zimmerman 25 Jun. 1965 132 p refs
(Contract NAS9-2599)
(NASA-CR-65139; R-6215) CFSTI: HC $4.00/MF $1.00 CSCL 20M

Mathematical models for statistical regression analysis of temperature, ablation, and char sensors are presented. Evaluation of heat shield thermometric sensor data shows that the models are able to describe and predict the response of individual sensors under specified operation conditions. Considerable variation in sensor response was observed from test to test under similar conditions. The regression analysis indicates that this lack of repeatability was due at least as much to variations in heat shield material specimens in which the sensors were embedded as to the sensors themselves. The stepwise regression program, written in Fortran computer language, is described in detail. J.M.D.

N65-32710# Little (Arthur D.) Inc., Cambridge, Mass.
THERMODYNAMICS OF CONDENSED AND VAPOR PHASES IN THE BINARY AND TERNARY SYSTEMS OF Be–B–O, Al–B–O, Si–O, Al–Be–O AND Al–B–F Final Report
Paul E. Blackburn 31 May 1965 65 p refs
(ARPA Order 315-62)
(AD-618523)

Vacuum balances and a mass spectrometer were used to obtain thermodynamic properties of binary and ternary vapor and condensed systems by Knudsen and Langmuir methods. An evaporation coefficient of 3×10^{-2} was found for the $B_2O_3(l)$ and 5×10^{-3} for $SiO_2(l)$. In the Be-B-O system there is only one condensed mixed phase, which is $Be_3B_2O_6(c)$ with a melting point of 1495° ±5° C. Effusion measurements on $Al_2O_3(l)$ and BeO were found to be in excellent agreement with previously obtained calculations. Vapor pressures are tabulated for boric oxide and silicon dioxide; and the Be-B-O, Al-B-O, and Al-B-F systems are considered as are rhenium and $AlF_3(g)$ and AlF(g). M.W.R.

N65-32723*# Pratt and Whitney Aircraft, West Palm Beach, Fla. Florida Research and Development Center
INVESTIGATION OF COMBUSTION INSTABILITY WITH LIQUID OXYGEN AND LIQUID OR COLD GASEOUS HYDROGEN PROPELLANTS, PHASE II Quarterly Progress Report No. 3
W. J. Mc Anally 30 Mar. 1965 59 p refs
(Contract NAS8-11024)
(NASA-CR-64602; PWA-FR-1308) CFSTI: HC $3.00/MF $0.50 CSCL 21B

Twenty-five tests with the 1 × 5-inch two-dimensional slab motors were conducted during the third quarter. Initial analysis of test results confirms the previously observed stabilizing trends of increased hydrogen temperature, increased injection momentum ratio, and increased chamber contraction ratio. Detailed analysis will be presented in the final report. Author

N65-32751*# National Aeronautics and Space Administration, Washington, D. C.
THERMODYNAMIC ANALYSIS OF CONDITIONS GOVERNING THE FORMATION OF ORE MINERALS IN THE PRECAMBRIAN PERIOD OF IRON-ORE FORMATION [TERMODINAMICHESKIY ANALIZUSLOVIY OBRAZOVANIYA RUDNYKH MINERALOV PRI METAMORFIZME DOKEMBRIYSKOY ZHELEZORUDNOY FORMATSII]
Yu. P. Mel'nik Aug. 1965 23 p refs Transl. into ENGLISH from Geol. Rudn. Mestorozhd. (USSR), no. 5 1964 p 3–14
(NASA-TT-F-8765) CFSTI: HC $1.00/MF $0.50 CSCL 20M

A thermodynamic study was made of certain supposed oxidizing and reduction reactions that occurred in the process of the rock metamorphism of the pre-Cambrian iron ore formation period. The stability range of the basic ferrous minerals; siderite, magnetite, and hematite; as determined by the temperature, pressure, and partial pressure of oxygen, water, carbon dioxide, and hydrogen during the mineral formation period, was established. R.N.A.

N65-32756*# Air Products and Chemicals, Inc., Allentown, Pa.
HEAT TRANSFER CHARACTERISTICS OF BOILING NEON AND NITROGEN IN NARROW ANNULI Final Report, Apr. 1962–Sep. 1963
A. Lapin and H. Totten Feb. 1965 252 p refs
(Contract NASr-107)
(NASA-CR-64465) CFSTI: HC $6.00/MF $1.50 CSCL 07D

Neon and nitrogen boiling under pool boiling conditions in narrow annuli was investigated. The study covered the case of a 7 1/2 inch long vertical heater with a nominal 3 inch outside diameter and gap sizes ranging from 0.006 to 0.080 inch. The experimental design concept allowed for visual observation simultaneously with data collection, which made it possible to relate data directly to behavior. The following equation correlating the nitrogen pool boiling data for all heaters, except the cadmium plated one, with an average percent deviation of ±16% was obtained:

$$Q/A_w = 87.2\,(\Delta T_b)^{1.20}$$

A generalized equation for annular gap boiling was derived on the assumption of convective type heat transfer. The concept of equivalent diameter was used to modify the characteristic dimension in the Nusselt and Reynolds numbers. The following equation correlated all annular gap boiling data obtained with nitrogen and neon with an average percent deviation of ±23%:

$$\frac{h_b D_e}{k_L} = 150 \left(\frac{D_e G}{\mu_L}\right)^{0.19} \left(\frac{L}{D_e}\right)^{0.82} \left(\frac{C_{pL}\,\mu_L}{K_L}\right)^{0.95}$$

The validity of the correlation over the wide range of parameters involved in the experimental work substantiates the assumptions made and concepts involved in the derivation of the equation. R.N.A.

N65-32773# George Washington Univ., Washington, D. C. School of Engineering and Applied Science.
THERMAL PORTS IN LINEAR NETWORK THEORY
D. K. Anand and Louis de Pian May 1965 126 p refs
(Contract Nonr-761(09))
(Rept.-3; AD-616387)

This dissertation presents an analytical study to consider thermal ports in networks. Onsager's equations are integrated and rewritten as port equations similar to immittance formalism. The port parameters resulting from Onsager's equations are found to be restrictive for general application to an electrical-thermal transducer. The concept of scattering matrices is applied to thermal ports and a set of equations is obtained. It is found that the scattering parameters are functions of the physical properties of the device and the biasing conditions. The scattering parameters are evaluated for static and dynamic operation. Signal power gain is considered and a criterion for passivity and activity is obtained. Author

N65-32799 Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.
BOUNDS IN MELTING SLABS WITH SEVERAL TRANSFORMATION TEMPERATURES
Ting-Shu Wu Feb. 1964 29 p refs
(Contract Nonr-4259(07))
(AD-617687)

The problem studied concerns the establishment of a uniqueness theorem and a comparison theorem, which are essential in the construction of bounds, for a multiphase slab which is insulated on one face and is heated in an arbitrary manner on the other. The material is assumed to possess an arbitrary but finite number of transformation temperatures. Each phase of the material may have distinct thermal properties, and each change of phase is assumed to take place at a given temperature and may be accompanied by the absorption of heat. Author

N65-32897# Bureau of Mines, Tuscaloosa, Ala.
SOME THERMAL PROPERTIES OF BERYLLIUM FLUORIDE FROM 8° TO 1,200°K
A. R. Taylor, Jr. and T. Estelle Gardner 1965 19 p refs
(BM-RI-6664)

The heat capacities of α-quartz form beryllium fluoride were measured at approximately 3° intervals from 8° to 300° K., using an adiabatic calorimeter. At 298.15° K the heat capacity and entropy were 12.39 cal/deg mole and 12.75 ±0.04 eu respectively. Enthalpy measurements were made with an ice calorimeter at approximately 30° intervals on the quartz and glassy forms of beryllium fluoride between 300° and 1,200° K. A melting point of 825° K and an α-β type transition at 500° K with a heat effect of 75 cal/mole were determined from the enthalpy data for the quartz-type sample. Beryllium fluoride glass crystallized spontaneously into the quartz modification at 500° K. Author

N65-32940# Southwest Research Inst., San Antonio, Tex.
STUDIES IN HIGH TEMPERATURE TECHNOLOGY Final Report, 1 Nov. 1961–30 Nov. 1964
U. S. Lindholm, E. J. Baker, Jr., L. M. Yeakley, and H. N. Abramson 15 Feb. 1965 49 p refs
(Contract AF 49(638)-1119)
(AD-464313)

Continued research in high temperature technology which focuses on determining the degree of interaction or response of engineering materials and structures to imposed environmental conditions is reported. Emphasized is the response of solids to very high heat transfer rates, particularly surface heating by either convective or radiative transfer. Summarized are results of research on various aspects of radiative heating of solids at very high power density and total energy inputs. Presented are data on transient heat conduction, transient stresses in solids induced by radiant surface heating, transient measurements at high temperature and heating rates during change of phase, and data on the arc-imaging furnace which was the primary experimental facility utilized. S.C.W.

N65-32962*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMBUSTION INSTABILITY LIMITS DETERMINED BY A NONLINEAR THEORY AND A ONE-DIMENSIONAL MODEL
Richard J. Priem and Donald C. Guentert Washington, NASA, Oct. 1962 45 p refs
(NASA-TN-D-1409) CFSTI: HC $2.00/MF $0.50 CSCL 21B

Regions of combustion instability in rockets were calculated from a nonlinear theory that considered the combustor to be an annular section with very small thickness and length. Two models were used to determine the local burning rate. One assumed that the burning rate was equal to the vaporization rate, the other assumed that the burning rate was equal to the chemical-reaction rate. The results show that a finite disturbance is required to produce instability. The instability regions were found to be a function of several design parameters and to be insensitive to the activation energy, specific-heat ratio, and order of reaction of the propellants. The vaporization-rate model was more sensitive to a pressure disturbance for design parameters corresponding to conditions encountered in large combustors. The chemical-reaction-rate model was more sensitive to a pressure disturbance for conditions corresponding to small research combustors. Wave shapes and characteristics were determined for various conditions. Author

N65-32963*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A VISUAL STUDY OF TWO-PHASE FLOW IN A VERTICAL TUBE WITH HEAT ADDITION
Yih Yun Hsu and Robert W. Graham Washington, NASA, Jan. 1963 24 p refs
(NASA-TN-D-1564) CFSTI: HC $1.00/MF $0.50 CSCL 20M

A visual study of two-phase flow with heat addition from the wall has been performed in two glass tube geometries. The flow regimes of bubbly, slug flow and transition from slug to annular flow were recorded by a high-speed motion-picture camera. Appreciable differences between adiabatic two-phase flow or two-component flow and nonadiabatic two-phase flow were observed. These differences emphasize the interaction of the heat transfer and the hydrodynamics in two-phase flow and the inadequacy of adiabatic studies in the accurate portrayal of the flow model. Author

N65-33027# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
INITATION OF DETONATION BY IMPACT ON GRANULAR EXPLOSIVES [CONTRIBUTION A L'ETUDE DE LA GENERATION DE LA DETONATION PROVOQUEE PAR IMPACT SUR UN EXPLOSIF]
Henri Bernier (Ph.D. Thesis—Paris Univ.) 1964 85 p refs In FRENCH; ENGLISH summary
(CEA-R-2497) CFSTI: HC $3.00/MF $0.75

A good number of experiments have shown up the particular behavior of granular explosives when they are detonated by barrier transmitted shocks. Similar results can be obtained when the shock is induced by impact. In this case, the pressure signal shape applied at the explosive is better known and both its intensity and duration can be varied. By using a mathematical model in which the law of chemical kinetics is a linear function of pressure, and different temperatures are used for solids and gases, it is possible to describe most of the behavior of detonation initiation in solid granular explosives. Author

N65-33066# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
THE EXPERIMENTAL INVESTIGATIONS OF LIQUID SODIUM HEAT TRANSFER AND FLUID FLOW IN THE LABORATORY CONVECTION LOOP [ZAGADNIENIA CIEPLNE I PRZEPLYWY W KONWEKCYJNEJ PETLI SODOWEJC]
F. Kaminski Dec. 1964 28 p refs In POLISH; ENGLISH summary
(Rept.-588/IX/R) CFSTI: HC $2.00/MF $0.50

This paper concerns the experimental investigation of heat transfer from the vertical pipe to liquid sodium in natural convection; and the calibration of the magnetic flowmeter for small volume rates of sodium. Results of measurements of heat losses from vertical unisolated pipes are also presented. Author

N65-33120# Dynatech Corp., Cambridge, Mass.
INVESTIGATION OF BOILING FLOW REGIMES AND CRITICAL HEAT FLUX Final Report, 15 Dec. 1963–15 Dec. 1964
M. Suo, A. E. Bergles, E. F. Doyle, L. Clawson, and P. Goldberg Washington, AEC, 1 Mar. 1965 99 p refs
(Contract AT(30-1)-3304)
(Dynatech-517; NYO-3304-3) CFSTI: $4.00

A program to investigate the mechanism of the critical heat flux condition from the standpoint of flow regimes was investigated. Available data for adiabatic steam-water flow were utilized to construct a flow regime map for the anticipated test conditions. An analysis indicated that the test section should be free of system hydrodynamic instability. The experimental facility was extensively modified so that it would be suitable for obtaining flow regime and critical heat flux information. Flow regime data were obtained for an 8 foot long, 0.4 inch diameter heated tube at 1000 psia over a range of flow rates and inlet subcoolings. By means of an electrical resistance probe, the flow regimes of bubbly and slug flow were reasonably well delineated. These data are compared with the adiabatic predictions. Critical heat flux data were also obtained and were found to be in agreement with available data. For the entire range of test conditions, the flow was found to be stable as predicted. Author

N65-33161# Pratt and Whitney Aircraft, Middletown, Conn.
THE VAPOR PRESSURE OF LITHIUM BETWEEN 1307 AND 1806K
D. V. Rigney, S. M. Kapelner, and R. E. Cleary Sep. 1965 15 p refs
(Contract AT(30-1)-2789)
(TIM-844)

The vapor pressure of lithium was determined in the temperature range from 1307 to 1806K. The results of a regression analysis of the data are given by the equation:

$$\log_{10} P(\text{atm}) = 4.8831 - \frac{7877.9}{T(^\circ K)}$$

The calculated heat of vaporization is 36.049±132 calories per mole. Author

N65-33189*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

RADIATIVE HEATING OF VEHICLES ENTERING THE EARTH'S ATMOSPHERE

Bradford H. Wisk Washington, NASA [1962] 43 p refs Presented to the AGARD Fluid Mech. Panel, Brussels, 3–6 Apr. 1962

(NASA-TM-X-56778) CFSTI: HC $2.00/MF $0.50 CSCL 20M

This paper considers the problem of calculating the equilibrium radiative heating of vehicles entering the Earth's atmosphere at velocities up to twice satellite velocity, with particular attention given to the cases of manned vehicles returning from trips to the Moon and Mars. Information and methods pertinent to the calculation of equilibrium radiative heating are presented and discussed. Numerical results are presented for evaluating stagnation-point heat flux and heat-flux distributions for spherical-segment noses for wide ranges of velocity and altitude. The results are for constant-energy shock layers of hot air which does not absorb radiation. The influence on stagnation-point radiative heat flux of absorption of shock-layer radiation, and the loss of shock-layer energy caused by the radiation is discussed and illustrated. Finally, calculated values of stagnation-point radiative heat flux and total heat are presented for manned lunar and Mars vehicles, and are compared with corresponding values for convective heating. Author

N65-33220*# RAND Corp., Santa Monica, Calif.

NUMERICAL ESTIMATION OF DERIVATIVES WITH AN APPLICATION TO RADIATIVE TRANSFER IN SPHERICAL SHELLS

H. H. Kagiwada, R. E. Kalaba, and R. E. Bellman Jun. 1965 16 p refs

(Contract NASr-21)

(NASA-CR-64643; RM-4617-NASA) CFSTI: HC $1.00/MF $0.50 CSCL 20M

The invariant imbedding equation for the scattering function for shell geometry is a nonlinear partial differential-integral equation, and its numerical solution presents difficulties. A simple method for integration of the above equation is presented. Integrals are approximated by finite sums using Gaussian quadrature, and partial derivatives are approximated by linear combinations of functional values. The original problem is approximated by a large system of ordinary differential equations with known initial conditions. Requisite auxiliary constants for numerical differentiation are given, as are the results of some trial calculations for the case of conservative isotropic scattering. Noteworthy differences between slab and shell geometry are observed, especially with grazing angles. Author

N65-33234# Auburn Research Foundation, Inc., Ala.

THERMAL DIFFUSIVITY. MEASUREMENT TECHNIQUES AND DATA ANALYSIS Quarterly Progress Report, Oct.–Dec. 1964

G. E. Tanger, G. H. Nix, S. C. Cheng, and G. W. Lowery Feb. 1965 39 p refs

(Contract DA-01-009-ORD-1023)

(Rept.-XI; AD-463826)

Three methods for determining the thermal diffusivity of solid propellants were investigated. A finite-difference method was found to be the best method currently available. Each method is discussed in the report and new test results are reported. A critical analysis of the errors involved was conducted. The errors considered include experimental, computational and specimen deviation errors. Author

N65-33259# United Aircraft Corp., East Hartford, Conn. Research Labs.

LAMINARIZATION OF NOZZLE WALL BOUNDARY LAYERS AS A MEANS OF REDUCING HEAT FLUX Monthly Progress Report, 1–31 Oct. 1964

R. L. O'Brien 13 Nov. 1964 11 p

(Contract AF 04(611)-9576)

(C-910100-16; AD-460954)

Testing of the short-throat-radius ($\Delta = 3$) nozzle was completed during this reporting period. A total of 124 runs have been made on this configuration. Heat transfer measurements were obtained in 66 of these runs. Of these 66 runs, a total of 13 are thought to have been affected by flow leakage and will be discarded. Boundary layer profile measurements were obtained in 12 of the runs for which heat transfer data were obtained and seven runs were made with the 0.25 inch diameter turbulence generator installed upstream of the slot. A total of 19 separate runs were made to determine the approach boundary layer conditions both with and without bleed and 34 runs were made to determine the freestream turbulence levels as a function of unit Reynolds number and axial location. Analysis of the data obtained in these tests is now under way. Preliminary analysis of these data indicates a significant effect of wall temperature but little or no effect of upstream bleed flow or mainstream turbulence level on the local heat transfer coefficients for the short-throat-radius configuration. Author

N65-33266*# National Astronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

TESTS WITH HYDROGEN FUEL IN A SIMULATED AFTERBURNER

W. R. Kerslake and E. E. Dangle 2 Jul. 1956 25 p refs

(NACA-RM-E56D13a) CFSTI: HC $1.00/MF $0.50 CSCL 21B

(Declassified)

An investigation was conducted in a 16-inch-diameter simulated afterburner using gaseous hydrogen fuel. No flameholder was used with a multipoint fuel injector. The burner length was varied from 9.5 to 38 inches. The afterburner-inlet conditions were: temperature of 1200° or 1550° F, pressure of 14 to 44 inches mercury absolute, and velocity of 300 to 780 feet per second. The measured combustion efficiency ranged from 85 to 98 percent over an equivalence-ratio range of 0.2 to 1.0. The cold-flow pressure-drop coefficient was 1.0 for the system. Spontaneous ignition was always possible at temperatures above 1200° F but was not possible below 1100° F for pressures and velocities tested. Author

N65-33275*# Illinois Univ., Urbana.

THEORETICAL STUDY OF RADIANT HEAT EXCHANGE FOR NON-GRAY NON-DIFFUSE SURFACES IN A SPACE ENVIRONMENT Semiannual Status Report No. 1, Feb.–Aug. 1965

R. G. Hering, A. F. Houchens, and T. Smith 1 Aug. 1965 25 p refs

(Grant NGR-14-005-036)

(NASA-CR-64669) CFSTI: HC $1.00/MF $0.50 CSCL 20M

The basic formulation of the non-gray non-diffuse radiant heat transfer in a space environment for a selected geometry is presented. A discussion and some observations concerning the bi-directional reflectance model required for the real surface analysis are also presented. An analysis is outlined which accounts for the directional dependence of emission and reflection for smooth plane surfaces. Results for radiation properties of smooth plane surfaces are presented. R.N.A.

N65-33279*# Massachusetts Inst. of Tech., Cambridge.
THEORETICAL AND EXPERIMENTAL STUDY OF THERMAL CONDUCTANCE OF NAVY SURFACES Semiannual Status Report, Nov. 1964–Jun. 1965
M. Michael Yovanovich [1965] 33 p refs
(Grant NGR-22-009-065)
(NASA-CR-64808) CFSTI: HC $2.00/MF $0.50 CSCL 20M

Theoretical studies on the contact area between two wavy surfaces an an experimental determination of contact conductance are presented. It was assumed that the deformation of the asperities is plastic and elastic while the waviness deforms elastically. Formulas are given for area of contact, load and area of one contact spot, and local deformation. The roughness and waviness coefficients of heat transfer in the presence of waviness are derived. The experimental apparatus and procedure for determination of contact conductance are described in detail. Stainless steel surfaces having roughness of about 100×10^{-6} were tested. The thermal conductivity was determined over the temperature range 200° F to 600° F and found to be constant at 14.6 Btu/hr/ft° F. Profiles of the surfaces were also obtained. C.T.C.

N65-33296# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE DETERMINATION OF THE HEAT CONDUCTIVITY ACCORDING TO A STATIONARY METHOD
E. Donth 16 Jul. 1965 11 p refs Transl. into ENGLISH from Exp. Tech. Physik (Berlin), no. 3, 1964 p 213–216
(FTD-TT-65-372/1+2+4; AD-467548)

Equations for heat conductivity determination were derived, providing a mathematical basis for a stationary method and allowing a portion of the errors to be estimated. This method states that a flow of heat causes a temperature difference in the probe, and at the same time the temperature of the arrangement, which is kept nearly adiabatic, changes uniformly and slowly. This method could also be applied to very low temperatures as the nonstationary characteristic is noticeable only in the corrections. W.M.R.

N65-33297# ARO, Inc., Arnold Air Force Station, Tenn.
THERMAL SPACE SIMULATION TESTING. COMPARISON OF RESULTS OBTAINED FROM SOLAR AND HEAT FLUX IRRADIATED SURFACES
N. C. Latture Arnold Eng. Develop. Center, Aug. 1965 38 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-65-107; AD-468409)

Tests were conducted in a vacuum chamber to demonstrate the feasibility of conducting space-thermal tests using tungsten filament lamps which do not have the same spectral output as the sun. A series of surfaces whose spectral absorptivities have been measured were irradiated by a carbon arc solar simulator and the tungsten lamps. By measuring the heat absorbed by the surface, the intensity at which the tungsten lamps must be set to have the surface absorb the same energy as from the solar simulator was determined. The intensity required from the lamps for black paint, white paint, aluminum, and gold was 1.00, 0.62, 1.14, and 3.39 solar constants, respectively. Author

N65-33298# Rocketdyne, Canoga Park, Calif. Research Dept.
A STUDY OF THE HEAT TRANSFER CHARACTERISTICS OF HOT GAS IGNITION Final Report, 1 May 1964–30 Apr. 1965
L. W. Carlson and J. D. Seader Edwards AFB, Calif., AF Rocket Propulsion Lab., Jun. 1965 199 p refs
(Contract AF 04(611)-9884)
(R-6197; AFRPL-TR-65-158; AD-469292)

Solid propellant rocket motors are frequently ignited by hot gas sources such as smaller burning solid propellant charges or pyrotechnic grains which exhaust their products of combustion into the motor grain port through convergent or convergent-divergent nozzles located in the head-end or aft-end of the motor. The results of an experimental program to develop correlations for predicting when and where such hot gas ignition occurs are discussed based on a pre-ignition transient convective heat transfer model. The hot gas source was nitrogen supplied to thin copper-walled test sections at pressures from 570 to 620 psig and temperatures from 550 to 950° F. A variety of geometrical configurations were studied including canted head-end igniter nozzles and circumferentially slotted motor ports. In all cases the motor ports had cylindrical cross sections. Significant differences in heat transfer characteristics between head-end and aft-end configurations were observed. Author

N65-33338# ARO, Inc., Arnold Air Force Station, Tenn.
VACUUM INTEGRATING SPHERES FOR MEASURING CRYODEPOSIT REFLECTANCES FROM 0.35 TO 15 MICRONS
B. E. Wood, B. A. Mc Cullough, J. P. Dawson, and R. C. Birkebak (Georgia Inst. of Tech.) Arnold Eng. Develop. Center, Aug. 1965 24 p refs
(Contract AF 40(600-1200)
(AEDC-TR-65-178; AD-468609)

A description of two new integrating-sphere systems is presented. A MgO-coated, vacuum integrating sphere is described as well as the components and techniques necessary for spectral measurements in the visible region. Spectral reflectance data are presented for CO_2 cryodeposits on a Cat-a-lac black substrate as functions of angle of incidence of the light beam and cryodeposit thicknesses. The sulphur-coated, infrared integrating sphere and components operated at atmospheric pressure are also described, and spectral reflectance data are presented for several different samples. The two sphere systems combined can be used over the wavelength range of 0.35 to 15 microns. Author

N65-33340# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
EMISSION OF OPTICAL RADIATION FROM HIGH PRESSURE GASES
Ralph Zirkind Dec. 1964 10 p refs
(Contract Nonr-839(34))
(PIBAL-814; AD-467863)

The observed spectral emittance of high temperature and density nitrogen was examined where the gas was compressed isentropically to a temperature and pressure of 7200° K and 4500 kg/cm^2 respectively. The analysis indicated that the radiation was composed of a near black body continuum and of nitrogen band emissions where the predominant bands were $N_2^+(1-)$, $N_2(1+)$ and $N_2(2+)$. Examination of the ratio of the latter two bands then made possible the reconstruction of the temperature history of the gas in the vicinity of peak compression. It was determined also that in comparison to the temperature, the relatively high density ratio of 250 played a minor role in the emitted radiant intensity. Author

N65-33344# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
ABLATION OF HOLLOW CYLINDERS
S. V. Nardo and J. E. Flaherty Jun. 1965 40 p refs
(Contract Nonr-839(23))
(PIBAL-907; AD-468933)

An approximate solution is presented for the ablation of a hollow cylinder whose inner surface is subjected to an axisymmetric heat source and whose outer surface is insulated. The products of melting or sublimation are assumed to be immediately removed upon formation. The analysis considers two distinct ablation problems. The first problem is concerned with a hollow cylinder of high-conductivity material, and the second problem considers a hollow cylinder of a low-conductivity material. In the case of the high-conductivity material, the spatial variation of temperature in the unablated solid is assumed to be a second-order polynomial; for the low-conductivity material, an exponential temperature profile is assumed. In both cases a heat balance integral technique, which satisfies the heat conduction equation on the average, is used to obtain the ablation time history. The solutions are in the form of second-order nonlinear ordinary differential equations in the position of the ablating surface. A step-by-step numerical integration was performed on both solutions for specific values of a heat transfer parameter and material property parameter. Ablation histories for these cases are presented in the form of curves for selected thickness ratios. Author

N65-33355*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ENTHALPY CALCULATED FROM PRESSURE AND FLOW-RATE MEASUREMENTS IN HIGH-TEMPERATURE SUBSONIC STREAMS
Ronald D. Brown and Bruce Fowler Washington, NASA, Sep. 1965 16 p refs
(NASA-TN-D-3013) CFSTI: HC $1.00/MF $0.50 CSCL 20M

A method of calculating the enthalpy of a high-temperature subsonic stream from measurements of the total pressure, the static pressure at the nozzle exit, the nozzle area, and the mass-flow-rate is presented. The enthalpy calculated by this method is compared with the enthalpy determined from the free-stream temperature as measured with a spectrometer and the enthalpy determined by an energy balance. The average difference between the values of free-stream enthalpy determined by the method presented and those determined by the spectrometric method is less than 10 percent at a flow rate of 0.011 slug/s (016 kg/s). Lower mass-flow-rates produce nonuniform pressure distributions across the stream and tend to increase the deviation between the enthalpy values. Author

N65-33356*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PRESSURE AND CONVECTIVE HEAT-TRANSFER MEASUREMENTS IN A SHOCK TUNNEL USING SEVERAL TEST GASES
Joseph G. Marvin and Clifford M. Akin Washington, NASA, Sep. 1965 30 p refs
(NASA-TN-D-3017) CFSTI: HC $2.00/MF $0.50 CSCL 20M

Pressures on a hemisphere-cylinder, and convective heat transfer on a hemisphere-cylinder, a blunted 30° cone, and the afterbody of a capsule-type shape were measured in air, nitrogen, carbon dioxide, and argon. The tests were performed in a combustion-driven shock tunnel at enthalpies from 3300 to 5400 Btu/lb, depending on the test gas. The pressure distributions on a hemisphere-cylinder did not differ significantly in the various test gases. This was influenced by nonequilibrium effects which occurred when some of the gases passed over the model. The stagnation-point heat-transfer data compared reasonably well with theory. On the basis of equivalent total enthalpy, the heat-transfer rate in argon was approximately 30 percent higher than that of the other gases. The heating-rate distributions on all the configurations were not influenced significantly when the test gas was changed. The distribution of heating on the hemisphere-cylinder was adequately predicted by theory using measured surface pressures. Author

N65-33371# ARO, Inc., Arnold Air Force Station, Tenn.
THERMAL RADIATIVE PROPERTIES OF CARBON CRYODEPOSITS FROM 0.5 TO 1.1 MICRONS
B. A. Mc Cullough, B. E. Wood, and J. P. Dawson Arnold Eng. Develop. Center, Aug. 1965 64 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-65-94; AD-468632)

An experimental study of the reflectance and angular distribution of the light reflected from a carbon dioxide cryodeposit is presented. The radiation wavelengths covered in the experiments were 0.5 to 1.1μ. These data were obtained as a function of angle of incidence of the light beam, substrate material, rate of condensation of the cryodeposit, system pressure, and cryodeposit thickness. The substrates used were polished copper, unpolished copper, Cat-a-lac black, and a front surface aluminized mirror. The theory and operation of the integrating sphere employed in these experiments are discussed. A deviation from the fundamental reflection law was observed in the distribution measurements. A discussion of the deviation is presented, and a comparison is made with previously published data. Author

N65-33382# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center.
THERMAL RESISTANCE OF CONTACTING METAL SURFACES AT HELIUM TEMPERATURES
N. V. Zabaritsky Apr. 1965 8 p refs Transl. into ENGLISH from Zh. Tekh. Fiz. (Leningrad), v. 21, no. 4, 1951 p 453–457
(RSIC-406; AD-616338)

The thermal contact of coneshaped copper surfaces O and A^1, located inside the brass housing K, were investigated. Included in the experiment were temperature measurements of sample O under different conditions which were made with the aid of the attached bronze thermometer. The thermal insulation of specimen O on the disconnected state was also measured. These measurements were used to check the conduction by the gas in chamber K. The relationship of the temperature of body O, at various temperature differences between the body and the external helium bath was measured under different quantities of heat emitted by the heater. The heat capacity of sample O, was determined from the curves of heating of sample O, during a given power expended by the heater. The results coincided with known values to an accuracy of 5% to 10%. The total heat flux from the body was calculated from the speed of its cooling and the heat capacity of its environment. It was assumed that heat transfer was caused basically by the transmission of heat through direct contact between two surfaces. Upon increasing the pressure of helium inside the chamber to 10^{-1}mm Hg, the amount of heat transferred increased threefold (under a load of 30 kg). R.W.H.

N65-33399# Aeronutronic, Newport Beach, Calif.
THERMODYNAMIC PROPERTIES OF PROPELLANT COMBUSTION PRODUCTS Second Quarterly Letter Report, 1 May–15 Jul. 1964
D. L. Hildenbrand [1964] 6 p refs
(Contract AF 46(638)-1397; ARPA Order 317)
(QLR-64-15; WO-2253; AD-614795)

Thermodynamic study of halides which are possible combustion products in advanced chemical propulsion systems is continuing. Preliminary results of measurement of the entropies of

vaporization and sublimation of various gaseous alkaline earth dihalides are described which will be used in tests of the structural and vibrational assignments of the dihalides. The mass spectrum of boron trifluoride for a number of temperatures from room temperature to 1981° K is tabulated and discussed. A beam modulation technique which will increase the effectiveness of the mass spectrometer for high temperature studies is discussed briefly. J.M.D.

N65-33418# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
PRESSURE DROP WITH SURFACE BOILING IN SMALL-DIAMETER TUBES
Thomas Dormer, Jr. and Arthur E. Bergles 1 Sep. 1964 86 p refs
(Contract AF 19(604)-7344)
(TR-8767-31; AD-461028)

Pressure drop for water flowing in small-diameter tubes under isothermal, nonboiling, and surface-boiling conditions was investigated. Experimental results for local pressure gradient and heat-transfer coefficients are presented. Heat-transfer results for nonboiling and surface boiling are in agreement with previous investigations. Isothermal friction factors compare favorably with conventional smooth-tube data. Nonboiling friction factors were well correlated with a wall-to-bulk fluid viscosity ratio. It is concluded that boiling pressure gradients cannot be correlated on the basis of local conditions alone. The axial build up of nonequilibrium vapor in the tube produces an increase in pressure gradient even when all other local parameters are constant. The heat-transfer–pressure-gradient analogy was investigated in the boiling region. For the chosen boiling-to-nonboiling ratios, the analogy was found to be valid only under limited conditions. Overall pressure-drop data are presented for numerous geometries and a range of flow conditions. Author

N65-33535# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
THERMODYNAMIC PROPERTIES OF BERYLLIUM HYDROXIDE. STUDY OF THE $BeO-H_2O-Be(OH)_2$ SYSTEM [PROPRIETES THERMODYNAMIQUES DE L'HYDROXIDE DE BERYLLIUM. ETUDE DU SYSTEME $BeO-H_2O-Be(OH)_2$]
Alain Baur and Alfred Lecocq Nov. 1964 27 p refs In FRENCH; ENGLISH summary
(CEA-R-2611) CFSTI: HC $2.00/MF $0.50

The study of the hydro-thermal decomposition of beryllium hydroxide has made it possible to determine the free energy of formation and the entropy. The results obtained are in good agreement with the theoretical values calculated from the solubility product of this substance. They give furthermore the possibility of acquiring a better understanding of the $BeO-H_2O-Be(OH)_2$ system between 20 and 1600° C. Author

N65-33536*# Harvard Coll. Observatory, Cambridge, Mass.
A COMPUTER PROGRAM TO SOLVE THE HEAT-CONDUCTION EQUATION IN THE LUNAR SURFACE FOR TEMPERATURE-DEPENDENT THERMAL PROPERTIES
Scientific Report No. 7
Jeffrey L. Linsky 15 Jul. 1965 54 p refs
(Grant NsG-64-60)
(NASA-CR-64833) CFSTI: HC $3.00/MF $0.50 CSCL 20M

A computer program is presented to solve the heat conduction equation for boundary conditions appropriate to the lunar surface during an eclipse and during a lunation. This program allows for very general representations of the temperature- and depth-dependent thermal properties in a multilayer model. Both infrared and microwave brightness temperatures may be predicted for the Moon and similar rotating bodies in which thermal conduction and radiative transfer are the most significant forms of energy transport near the surface. Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N65-32494 Advisory Group for Aeronautical Research and Development, Paris (France).
INTERDEPENDENCE BETWEEN FUNDAMENTAL RESEARCH AND APPLIED RESEARCH [INTERDEPENDANCE ENTRE LA RECHERCHE FONDAMENTALE ET LA RECHERCHE APPLIQUEE]
M. Frejacques *In its* Advan. in Mater. Res. in the NATO Nations 1963 p 349–360 in FRENCH (See N65-32475 21-26) CFSTI: HC $8.35/MF $2.50

The difficulties in drawing a clear distinction between fundamental and applied research are discussed. The functions and interactions among the academic, industrial, and private consulting sectors of research are described, with emphasis on research in chemistry. Transl. by J.M.D.

N65-32500 Canada. Dept. of Mines and Tech. Surveys, Ottawa.
ORGANIZATION OF MATERIALS RESEARCH IN CANADA
H. V. Kinsey *In* AGARD Advan. in Mater. Res. in the NATO Nations 1963 p 457–461 (See N65-32475 21-26) CFSTI: HC $8.35/MF $2.50

Presented are positive conclusions which have led to the following principles or procedures. Canada's financed research establishments are only in part managed by the Federal Civil Service. Its government-financed research is carried out in the various research laboratories with a degree of control depending on the scientific content of the particular project. In defense initiated research, the university research centers have direct financial relations with civilian agencies of the armed services. R.W.H.

N65-32501 Institut de Recherches de la Siderurgie, Saint-Germain-en-Laye (France).
NOTES ON THE ORGANIZATION AND COORDINATION OF MATERIALS RESEARCH IN FRANCE [NOTES SUR L'ORGANISATION ET LA COORDINATION DES RECHERCHES MATERIAUX EN FRANCE]
Ch. Crussard *In* AGARD Advan. in Mater. Res. in the NATO Nations 1963 p 463–472 In FRENCH (See N65-32475 21-26) CFSTI: HC $8.35/MF $2.50

A catalogue of the French laboratories working on materials research is presented. The organizations on which they depend are listed, along with an indication of their main activities. R.W.H.

N65-32502 Organization for Industrial Research, TNO, The Hague (Netherlands).
MATERIALS RESEARCH IN THE NETHERLANDS
H. F. J. Freutel *In* AGARD Advan. in Mater. Res. in the NATO NATIONS 1963 p 473–482 (See N65-32475 21-26) CFSTI: HC $8.35/MF $2.50

A review is given which is mainly limited to fundamental materials research and applied research on structural materials, e.g., metals and reinforced plastics. In sections, ranging from rheology to wear, material properties are discussed by members in about 25 sessions a year and numerous informal study groups. R.W.H.

N65-32503 Central Inst. for Industrial Research, Blindern (Norway).
MATERIALS RESEARCH ORGANIZATION IN NORWAY
H. Kjollesdal *In* AGARD Advan. in Mater. Res. in the NATO Nations 1963 p 483–486 (See N65-32475 21-26) CFSTI: HC $8.35/MF $2.50

The production of electricity, which is larger per capita than in any other country, has given rise to a well-established electro-metallurgical and electrochemical industry. The production consists mainly of raw materials and semimanufactured articles such as ferro-alloys, pig iron, constructional steel, Mg-alloys, Al-ingots and slabs, electrolytic Zn, Ni, Cu, Co, and noble metals. The research has been directed towards processes, rather than to the finish and the properties of the material itself. R.W.H.

N65-32504 National Physical Lab., Teddington (England).
THE ORGANIZATION OF MATERIALS RESEARCH IN GREAT BRITAIN
N. P. Allen *In* AGARD Advan. in Mater. Res. in the NATO Nations 1963 p 487–499 (See N65-32475 21-26) CFSTI: HC $8.35/MF $2.50

Research grants and development activities are discussed, and the Department of Scientific and Industrial Research (DSIR) stations are listed. A tabulation of various research associations is included, together with data on their particular materials interest. R.W.H.

N65-32505 Battelle Memorial Inst., Washington, D. C.
THE ORGANIZATION OF MATERIALS RESEARCH IN THE UNITED STATES
W. J. Harris, Jr. *In* AGARD Advan. in Mater Res. in the NATO Nations 1963 p 501–511 (See N65-32475 21–26) CFSTI: HC $8.35/MF $2.50

Research and development in the fields of materials may range from very basic studies to the design of specific components. Data considered are: (1) discussion of the approach to several historically critical national materials problems—shortages of materials encountered during the Korean–United Nations actions, materials for reentry bodies, miniaturization of electronic components, and general support of basic research; (2) the administration of materials research and development programs; and (3) the role of committees in the organization and administration of research and development, including general problems. R.W.H.

N65-32585# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 210
25 Aug. 1965 44 p Transl. into ENGLISH from Chinese (JPRS-31709; TT-65-32204) CFSTI: $2.00

CONTENTS:

1. INSTRUMENTS FOR RADIATION DETECTION AND MEASUREMENT K. Shih p 1–6 (See N65-32586 21-24)
2. MEDICAL APPLICATION OF ULTRASOUND C.-c. Hsu and Y.-c. Chou p 7–12 (See N65-32587 21-04)
3. TOOLS FOR OBSERVING SPLIT-SECOND CHANGES Chou Hsuan p 13–14
4. TRACER ATOMS IN THE HANDS OF AGRICULTURAL SCIENTISTS Nai-lin Chin p 15–19
5. MORE ROOT-TUBER BACTERIA FERTILIZER PRODUCED TO AID GREEN FERTILIZER PRODUCTION p 22–23
6. UNITE SCIENCE AND ENGINEERING IN ORDER TO DEVELOP MATHEMATICS Chao-chih Kuan p 24–38
7. SANITATION AND PLAGUE PREVENTION WORK CONSUMMATED IN CHIA-HSIANG, SHANTUNG p 39–41

N65-32650# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 203
9 Aug. 1965 162 p refs Transl. into ENGLISH of 18 articles from K'o-hsueh T'ung-pao (Peking), no. 12, 17 Dec. 1964 p 1037–1063, 1069–1080, 1092–1129
(JPRS-31473; TT-65-31969) CFSTI: $5.00

CONTENTS:

1. RESEARCH ON THE CULTIVATION MEASURES AND DIAGNOSIS FROM THE SEEDLING ECOLOGY OF A HIGH-YIELD LATE-GROWN NON-GLUTINOUS RICE (ORYZA SATIVA) Yung-k'ang Ch'en, Chi-lin Ts'ui, Li-chiung Yang, and Yu-keng T'ang p 1–24 refs
2. NI CHIH-FU DRILL Chih-fu Ni and Ch'i-hsun Yu p 25–47 refs
3. A STUDY OF ARTIFICIAL ACTIVE IMMUNIZATION AGAINST RUBEOLA Fu-t'ang Chu p 48–73 refs
4. THE STANDARD TYPE OF CONSTANT COEFFICIENT LINEAR PARTIAL DIFFERENTIAL EQUATIONS OF THE SECOND-ORDER, TWO VARIABLES, AND TWO UNKNOWN FUNCTIONS TYPE L.-k. Hua, T.-c. Wu, and L. Wei p 74–80 refs (See N65-32651 21-19)
5. RESEARCH ON THE ROTARY RESONANCE ON ANTI-RADIATION SULPHIDE ELECTRONS W.-c. Hsin, M.-j. Yao, C.-l. Chang, and C.-h Hua p 81–87 refs (See N65-32652 21-04)
6. THE PRELIMINARY DISCUSSION OF THE ARCHITECTONIC CHARACTERISTICS AND THE GEOTECTONIC REGIONAL CLASSIFICATION PROBLEM OF A-LA-SHAN REGION p 88–92 refs
7. GEOCHEMICAL RESEARCH OF GALLIUM IN ALKALI ETCHED GRANITE AND ITS SIGNIFICANCE Ying-chun Liu p 93–97 refs
8. SPECTRUM OF THE SECOND HARMONICS PRODUCED IN THE ADP CRYSTAL BY Nd^{3+} EXCITED GLASS IN ITS EXCITED LIGHT EMISSION STATE Y.-s. Tsai, H.-s. Li, and F.-h. Kan p 98–102 refs (See N65-32653 21-16)
9. CALCULATION OF RELATIVE VOLATILITY OF DILUTE NON-ELECTROLYTE SOLUTIONS T.-n. Wang p 103–112 refs (See N65-32654 21-06)
10. THE RELATIONSHIP BETWEEN THE TRANSFORMATION OF ROLLING TEXTURE AND THE DISPLACEMENT RATE OF ACCUMULATION LAYERS OF NICKEL-MOLYBDENUM ALLOY H.-y. Chang and H.-f. Sun p 113–120 refs (See N65-32655 21-17)
11. THE ELECTRIC MOTIVE FORCE OF $SnCl_2$–KCl SOLUTION J.-w. P'eng and S.-t. Wen p 121–125 refs (See N65-32656 21-06)
12. PROGRESS IN CELLULOSE GRAFT COPOLYMER RESEARCH Kao Chieh p 126–140 refs
13. APPLICATION OF THIN COLOR LAYERS IN INORGANIC ANALYSIS. II. SEPARATION AND DETERMINATION OF SELENIUM AND TELLURIUM C.-t. Hu and C.-l. Liu p 141–145 refs (See N65-32657 21-06)

14. ALL-CHINA SHIPBUILDING TECHNOLOGY SYMPOSIUM Hsiu-jen Sang p 146–149
15. FARMLAND PROTECTIVE FOREST SYMPOSIUM FOR NORTH CHINA Ch'ang-shun Ch'i p 150–152
16. THE FIRST ALL-CHINA FOREST SOIL SYMPOSIUM Ch'ang-hua Li p 153–154
17. FIRST ALL-CHINA PLANT-SEED MIGRATION AND TAMING SYMPOSIUM Hung-chih Chin p 155–157
18. DRY LAND GEOGRAPHY SYMPOSIUM AT LANCHOW Ning-shu Chu p 158–161

N65-32675# Library of Congress, Washington, D. C. Aerospace Technology Div.
FOREIGN SCIENCE BULLETIN, VOLUME 1, NO. 8 A Monthly Review of Selected Foreign Scientific and Technical Literature
Aug. 1965 74 p refs Sponsored by Dept. of Defense

CONTENTS:

1. GIANT RADIO TELESCOPE S. G. Hibben p 1–8 refs (See N65-32676 21-07)
2. RAMAN SCATTERING LASERS Y. Ksander p 9–17 refs (See N65-32677 21-16)
3. FORECASTING SOLAR FLARES D. Michaels p 18–20 refs (See N65-32678 21-29)
4. THE SECOND "MAN-IN-SPACE" SYMPOSIUM AND PROBLEMS OF VOSKHOD-2 LIFE SUPPORT SYSTEMS B. Mandrovsky p 21–27 refs (See N65-32679 21-05)
5. EPITAXIAL GROWTH OF ALUMINUM NITRIDE THIN FILMS J. G. Kourilo p 28–30 refs (See N65-32680 21-17)
6. SCIENCE & TECHNOLOGY NOTES [SPACEFLIGHT MEDICAL MONITORING, EXTRAVEHICULAR ACTIVITY, GEODETIC AND DISTANCE-MEASURING INSTRUMENTS, POLAR MAGNETIC PERTURBATIONS, ETC. (USSR)] p 31–48 refs
7. CONFERENCES [LASERS (USA); ARTIFICIAL SATELLITES, CELESTIAL MECHANICS, PROBABILITY THEORY AND MATHEMATICAL STATISTICS, PHYSICAL PROPERTIES OF ROCKS, ATMOSPHERIC AND HYDROSPHERIC BOUNDARY LAYERS, AND POLYMERS (USSR).] p 49–59
8. BOOK REVIEWS [RAREFIED GASES AND EXPERIMENTAL INVESTIGATIONS IN GRAVIMETRY (USSR).] p 65–70 refs

N65-32692# Army Materials Research Agency, Watertown, Mass. Materials Technology Div.
A REPORT GUIDE TO MAGNETIC PARTICLE TESTING LITERATURE
Ernest H. Rodgers and Charles P. Merhib Jun. 1965 80 p refs
(AMRA-MS-65-04; AD-617758)

An annotated bibliography of magnetic particle testing literature is reported. The primary objective of this compilation is to provide a simple and fast access to information on the subject of magentic particle testing, and to provide sufficient information in the form of abstracts and word descriptors to make the listing useful. Also included is an author index. Among the research presented are: nondestructive testing studies of hardware for solid rocket mogrs, a new method of obtaining magnaflux patterns and their permanent records, and an analysis of trends in nondestructive testing. S.C.W.

N65-32695# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PNEUMONICS
Yu. Popov and Yu. Pukhnachev 19 Jul. 1965 21 p ref Transl. into ENGLISH from Nauka i Zhizn (Moscow), no. 1, 1965 p 10–18
(FRD-TT-65-742-1+2+4; AD-618319)

The construction of control instruments on air streams without the use of mechanical components is considered as the backbone for the development of a whole series of automation instruments and designated as pneumonics. The so-called alphabet of pneumonics or flow automatics is considered, and various schematics of amplifiers, memory call on streams, and logical elements are presented. The understanding of flow relay is considered vital to the development of "alphabetical" instruments of pneumonics. The advantages of pneumonics devices are discussed, and it is pointed that flow instruments can operate under varying conditions of overloads and vibrations, under radiation exposure, and in a wide range of temperatures. Examples of such devices are automatic artificial hearts and aerodynamic oscillation generators. Designing control systems for pneumohydraulic and other elements are also considered. M.W.R.

N65-32696# RAND Corp., Santa Monica, Calif.
STATISTICAL ESTIMATION BY THE EMPIRICAL BAYES METHOD: SOME EXTENSIONS AND LOGISTICAL APPLICATIONS
S. James Press Jun. 1965 43 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4442-Pr; AD-617606)

Explicit estimators are presented for the univariate and multivariate exponential family of distributions, for distributions with nuisance parameters, and for the distribution of a family of random variables. Examples are given to show how these data apply to logistical problems, particularly to the estimation of Poisson-process generated demand parameters and repair-time distribution parameters. An empirical Bayesian approach is taken for which there is no need to assume any particular form for the *a priori* distribution of the parameter. The procedure can be used to improve methods of estimating statistical decision parameters in such logistical problems as reliability, maintenance, and supply. M.W.R.

N65-32701# Army Missile Command, Huntsville, Ala.
VALUE ENGINEERING SYMPOSIUM, ADVANCEMENT IN THE STATE OF THE ART
[1964] 448 p Symp. Held at Redstone Arsenal, Ala., 18–19 Nov. 1964
(AD-616516)

CONTENTS:

1. VALUE DECISION TECHNIQUES p 15–49
2. COST EFFECTIVENESS p 51–98
3. COST ANALYSIS TECHNIQUES p 99–158
4. MATHEMATICAL EVALUATION OF VALUE p 159–186
5. TARGET COST PROGRAMS p 187–190
6. VALUE ENGINEERING RESEARCH p 191–210
7. PROGRAM MANAGEMENT p 211–280
8. VALUE ENGINEERING IN PAPERWORK OPERATIONS p 281–297
9. VALUE ENGINEERING IN RESEARCH AND DEVELOPMENT p 299–328
10. VALUE ENGINEERING APPLICATIONS p 329–392
11. VALUE ENGINEERING - GENERAL p 393–447

N65-32892# General Motors Corp., Indianpolis, Ind. Allison Div.
ALLISON RESEARCH AND ENGINEERING REPORT, VOLUME 7, THIRD QUARTER 1965
1965 23 p refs

CONTENTS:

1. RANDOM MOTION VIBRATION ANALYSIS J. E. Westwick and E. W. Sickmeier p 2–14 refs (See N65-32893 21-32)

2. LITHIUM CHLORINE ELECTROCHEMICAL ENERGY CONVERSION D. A. J. Swinkels p 15–20 refs (See N65-32894 21-03)

N65-33125*# Colorado Univ., Boulder. Inst. of Behavioral Science.
THE IMPACT OF SPACE AND SPACE-RELATED ACTIVITIES ON A LOCAL ECONOMY. A CASE STUDY OF BOULDER, COLORADO. PART II: THE INCOME-PRODUCT ACCOUNTS
Don Seastone, Ernest R. Bonner, Charles M. Franks, and William Mc Cormick Jul. 1965 179 p refs
(Grant NsG-474)
(NASA-CR-64600) CFSTI: HC $5.00/MF $1.00 CSCL 05C

Part II of a two-part study to develop estimates of the total impact of space and space related activities on the economy of Boulder, Colorado, reports the results of an investigation concerned with developing income and product accounts for the Boulder area analogous to those reported regularly for the nation as a whole. The income and product accounts are used as techniques for measuring regional economic activity and as instruments for a general multiplier analysis of space expenditures. Data collection procedures for the income and product accounts and aggregate multiplier analysis are discussed. The impact of government activities on the Boulder area was studied by bringing together data on tax and nontax payments by residents and relating them to the expenditures of all government units in Boulder. A model of regional growth based on income, expenditures, product, and employment behavior was constructed and used to show the impact of space and other expenditures on the growth of the Boulder economy. R.N.A.

N65-33133*# Pennsylvania Univ., Philadelphia. Wharton School.
INTERINDUSTRY RELATIONSHIPS IN THE PHILADELPHIA ECONOMY
Ger2d J. Karaska [1965] 25 p refs Presented at the Meetings of the Assoc. of Am. Geographers, Columbus, Ohio, 20 Apr. 1965 Sponsored by NASA
(NASA-CR-64620) CFSTI: HC $1.00/MF $0.50 CSCL 05C

The impacts of changes in federal research and development expenditures upon the regional economy of the Philadelphia area were studied to provide basic data that would help to orient local industrial development plans. An input-output analysis identified those industrial linkages by their internal and external flow of goods, which served as the principle source of income generation for the investigated region. Sampling procedures consisted of almost complete inquiries of firms with more than 50 employees, and were supplemented by detailed industrial directories compiled by the Department of Internal Affairs. A sample analysis of the regional paper and paper products industrial complex was made, and it was found that only two of the nine converted paper and board industries sell more than 50 percent of their products to local industries. G.G.

N65-33147*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
BIBLIOGRAPHIES OF THE JET PROPULSION LABORATORY NO. 39-1 THROUGH 39-5 Cumulative Bibliographic Index No. 41-1
15 Jul. 1965 79 p refs
(Contract NAS7-100)
(NASA-CR-64613) CFSTI: HC $3.00/MF $0.75 CSCL 05B

A bibliographic index derived from various publications, memorandums, reports, technical releases, and documents on aerospace technology and related fields is presented. R.N.A.

N65-33190*# Colorado Univ., Boulder, Bureau of Economic Research.
THE IMPACT OF SPACE AND SPACE-RELATED ACTIVITIES ON A LOCAL ECONOMY. A CASE STUDY OF BOULDER, COLORADO. PART I: THE INPUT-OUTPUT ANALYSIS
William H. Miernyk, Ernest R. Bowner, John H. Chapman, Jr., and Kenneth Shellhammer Jul. 1965 176 p refs
(Grant NsG-474)
(NASA-CR-64780) CFSTI: HC $5.00/MF $1.00 CSCL 05A

The Boulder, Colorado economy is presented in an historical framework and an input-output analysis is made to show the impact of the space program on local economy. Definitions and sources of data, structure of the Boulder economy, and various income and employment multipliers are considered. Basic assumptions of a Leontief open, static input-output model are presented and the four quadrants, processing, final demand, direct sales, and payments, are described. Technical coefficients for use with the model are developed, and regional and interregional iknput-output models are discussed. Triangularized tables detail the interindustry flow of goods and services, direct purchases per dollar of output, and requirements per dollar of delivery to final demand. Appendices include the household questionnaire used, data sources for development of control totals, calculation of student and nonstudent expansion factors, and transitory income in 1963. Direct effects on areas outside Boulder as a result of a nine million dollar increase in sales are presented in a table. M.W.R.

N65-33238# Aerospace Corp., El Segundo, Calif. Administration Div.
MONTHLY SUMMARY OF TECHNICAL DOCUMENTARY REPORTS, 1–31 JANUARY 1965
H. Lemons 10 Feb. 1965 26 p
(Contract AF 04(695)-469)
(CSR-469(9990)MS-7; AD-451792)

Abstracts are presented on a number of technical aerospace reports and include tumbling experiments on a gyro, an orbit determination program, radar resolution of moving targets, a digital systems program, atmospheric density experienced by radiation belt protons, feasibility study of speed beam antennas for the defense communication satellite program, blast loading tests of conical shells, etching and crystal growth of the GaAs–Sn system, thermal diffusivity measurement technique for very high temperatures, and range rate and antenna angle data evaluation study. R.N.A.

N65-33423# White Sands Missile Range, N. Mex.
A GLOSSARY OF RANGE TERMINOLOGY
[1965] 161 p
(Doc.-104-64; AD-467424)

A glossary containing definitions, abbreviations, acronyms, and other pertinent information is presented for National

Missile Range operations. The major terms and subdivisions are listed alphabetically, and many terms are cross-referenced to supply additional information or clarification. W.M.R.

N65-33445# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
RESEARCH AND DEVELOPMENT PROGRAMS Quarterly Report, Oct.–Dec. 1964
R. H. Cramer et al [1964] 77 p refs
(Contract NOw-62-0604-c)
(U-RQR-64-4; AD-461643)

Research and development programs in the following areas are reported: Polaris support, exploratory development, high temperature research, fundamental research, special laboratories, and special assignments. Among the research cited are included: Polaris re-entry studies, wideband radome antenna research; hypersonic gas dynamics; chemical and plasma dynamics research; data processing laboratory updating; and research on supersonic combustion. S.C.W.

N65-33500*# Washington Univ., St. Louis, Mo.
MEASURES OF THE IMPACT OF DEFENSE AND SPACE PROGRAMS
Murray L. Weidenbaum 27 Aug. 1965 35 p refs Presented at Ann. Meeting of the Am. Statist. Assn., Philadelphia, 9 Sep. 1965
(Grant NsG-342)
(NASA-CR-64837) CFSTI: HC $2.00/MF $0.50 CSCL 05C

Three aspects of the problem of gaps in statistical information on the economic impact of defense and space expenditures are discussed and include the current stock of information, the increment that will soon become available, and the high priority gaps that need to be filled. Findings from available data show that about one-tenth of the Nation's resources are being devoted to national security programs. Many of these resources are located in a relatively few industries and regions. The industries are predominantly the high technology ones: aircraft, electronics, and supporting firms in such fields as ordnance and instruments. The regions most heavily involved are predominantly areas where these industries tend to cluster, the West Coast and the highly industrialized states of the Northeast. The bulk of the population, area, and industry of the country is only marginally affected by defense and space programs. Only a few companies in a few regions are greatly benefitted or adversely affected by these programs. R.N.A.

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North Carolina: Charlotte
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Oklahoma: Oklahoma City
Pennsylvania: Pittsburgh
Tennessee: Memphis
Texas: Fort Worth, San Antonio
Washington: Seattle
Wisconsin: Milwaukee

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—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

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TECHNICAL MEMORANDUMS: Information receiving limited distribution because of preliminary data, security classification, or other reasons.

CONTRACTOR REPORTS: Technical information generated in connection with a NASA contract or grant and released under NASA auspices.

TECHNICAL TRANSLATIONS: Information published in a foreign language considered to merit NASA distribution in English.

SPECIAL PUBLICATIONS: Information derived from or of value to NASA activities. Publications include conference proceedings, monographs, data compilations, handbooks, sourcebooks, and special bibliographies.

TECHNOLOGY UTILIZATION PUBLICATIONS: Information on technology used by NASA that may be of particular interest in commercial and other nonaerospace applications. Publications include Tech Briefs; Technology Utilization Reports and Notes; and Technology Surveys.

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